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ABSTRACT

Based on the idea that active participation stimulates the processes by which learning takes place, this document provides teachers and students with a variety of information and learning activities dealing with energy. Concepts about energy are presented through the use of laboratory experiments, demonstrations, worksheet exercises and individual and group activities. The material focuses on: (1) kinetic and potential energy; (2) energy sources; (3) petroleum and its uses; (4) soap and detergents; (5) automobile designs; (6) coal products and uses; (7) the effect of air pollution on nylon; (8) electricity; (9) conducting heat; (10) natural gas; (11) hydroelectric power; (12) water use and conservation; (13) solar energy; (14) steam power; (15) energy conservation techniques; and (16) nuclear energy. Included are energy games, along with reproducible handouts for many of the activities, quizzes, self-checks, and an answer key. (TW)

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A Good Apple Science Activity Book for Grades 5-8+

SUPERIFIC SCIENCE

Book XI

Learning About Energy

U.S. DEPARTMENT OF EDUCATION
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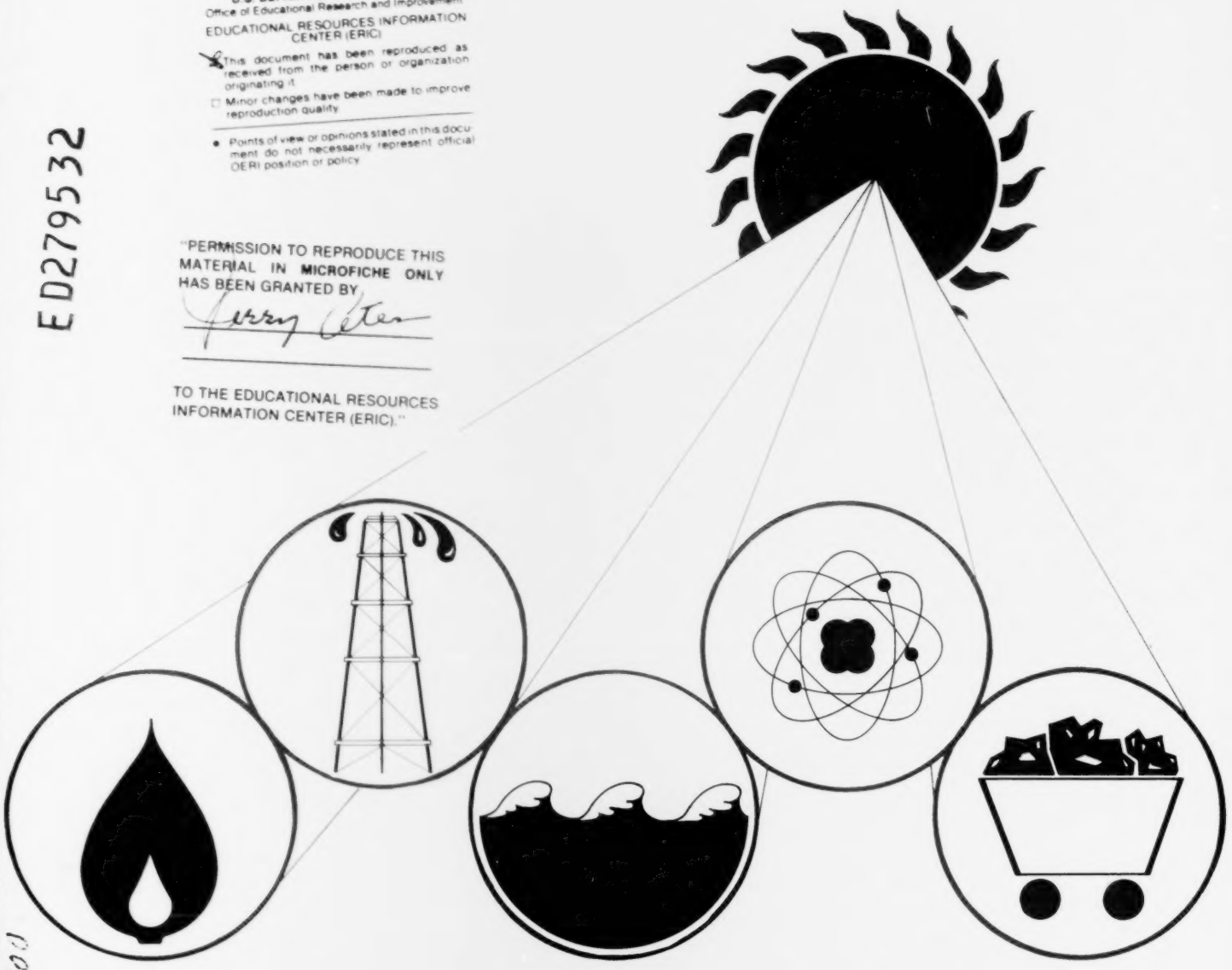

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Illustrated by Linda Akins

SE 047 801

Energy

by

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Cover by Mark Austin

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INTRODUCTION

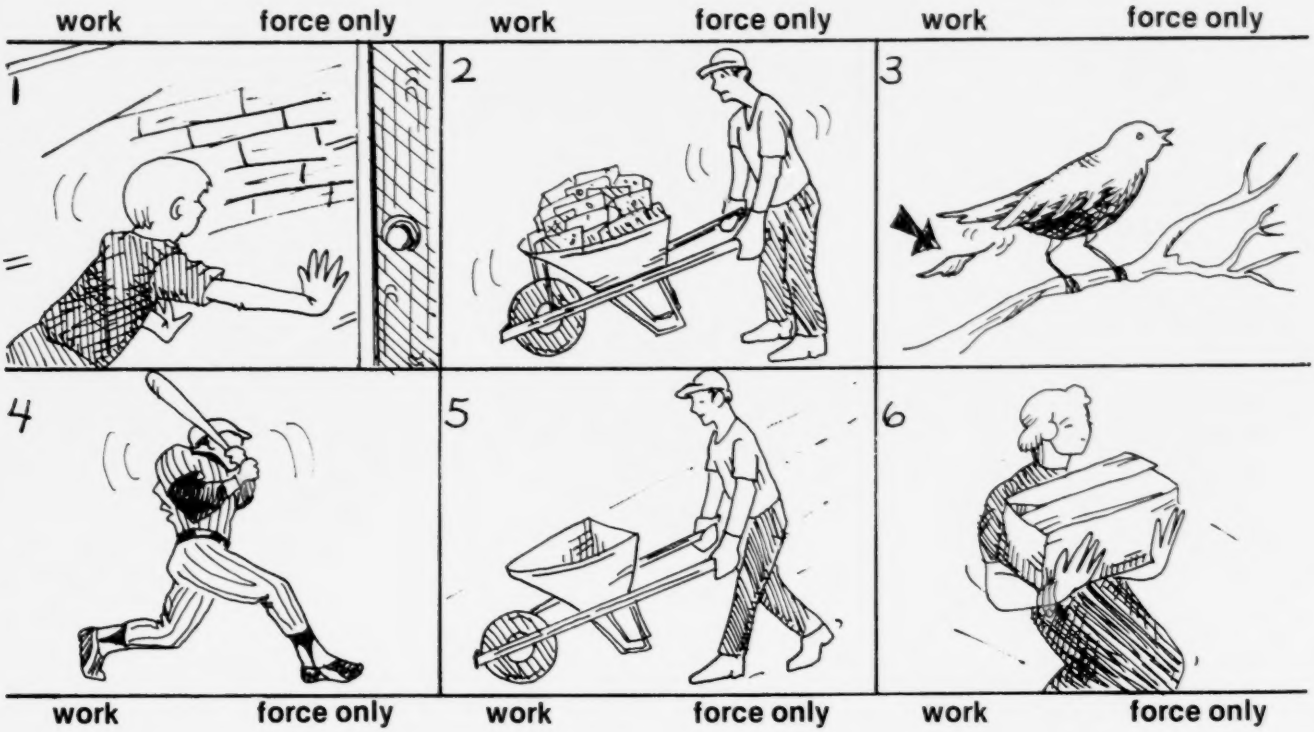
Future and present energy supplies are the concern of every country on earth. We have become accustomed to a way of life made possible by the consumption of enormous quantities of energy. Fossil fuels, which we once considered to be inexhaustible, are rapidly being depleted at ever increasing rates. Surely few, if any of us, care to live as our ancestors did, without electricity, modern transportation, plastics, and the variety of medicines to which we have become accustomed. Yet all of these conveniences are linked in one way or another to fossil fuels.

An understanding of energy, what it is, how we use it, and how it is supplied is the first step to a successful solution to the energy dilemma facing us. With that in mind, this book was written.

WHAT IS ENERGY?

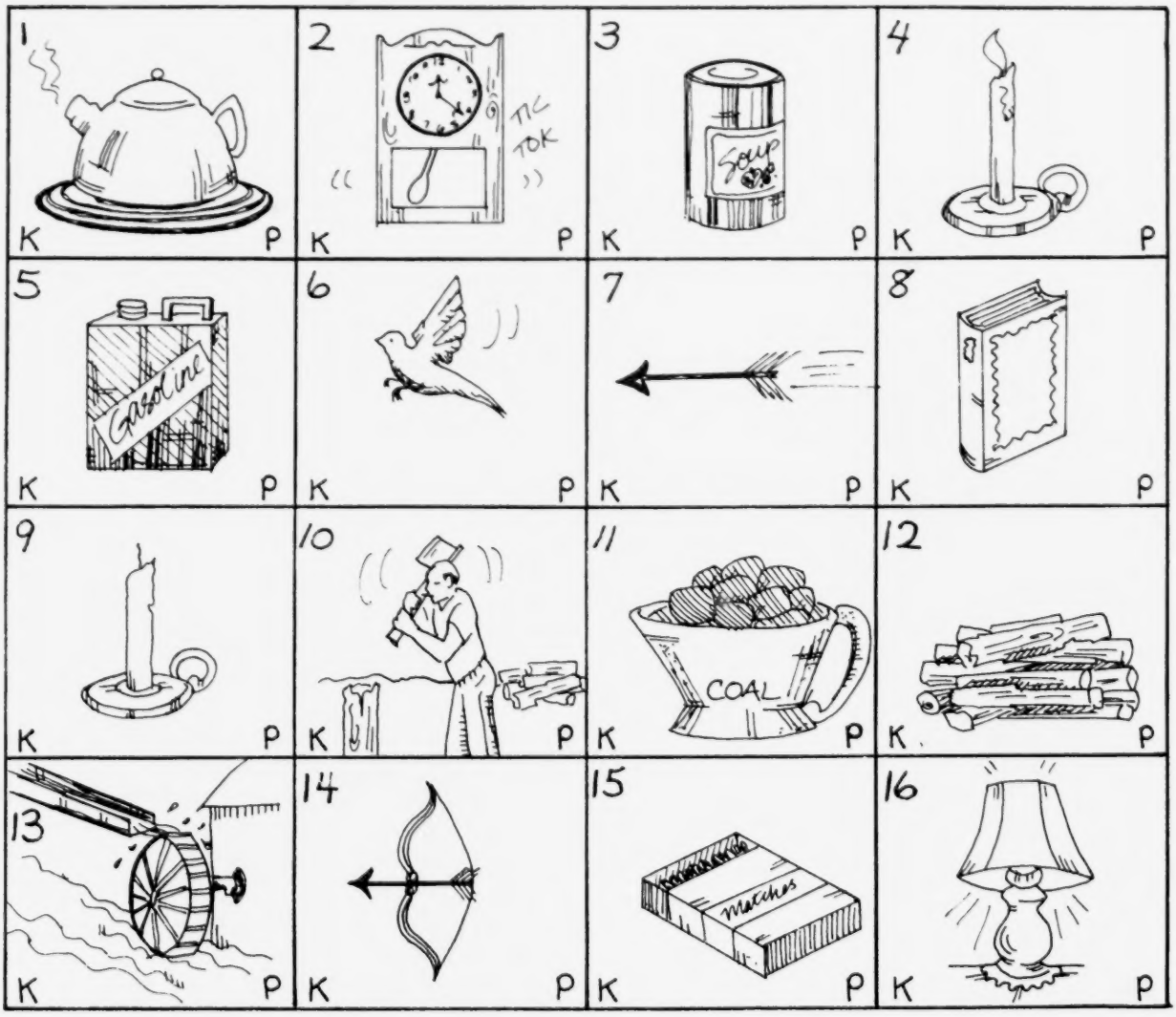
What is energy? To a scientist, energy is the ability to do work. Most people think of work as mowing lawns, cleaning rooms, or some sort of similar activity. They are correct, but to scientists playing baseball or checkers is also work. The reason is that work occurs whenever something is moved. You may push as hard as you can for hours on end against a brick wall, but unless the wall moves, you have done no work, scientifically speaking. Brush a feather off your desk and because the feather moved, work has been done. All work is accomplished by pushing or pulling. In order to push or pull an object, force must be exerted. The force needed to do work requires energy, but only when the force moves an object has work been accomplished.

Indicate whether work is being accomplished or whether force is merely being exerted in each of the following pictures by circling the correct term.



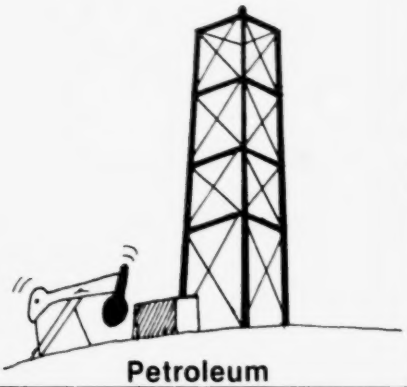
KINETIC AND POTENTIAL ENERGY

Energy can be classified in several ways. One way in which we classify energy is whether or not it is moving or at rest. Energy which is moving and therefore being used is called kinetic energy. Energy at rest is called potential energy. Decide whether the following are examples of kinetic (moving) or potential (resting) energy. Circle either **K** or **P**.



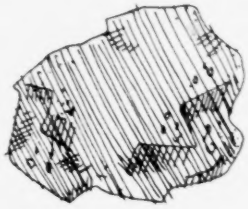
PRIMARY ENERGY SOURCES

Match the primary energy sources pictured below to the descriptions on the following page.



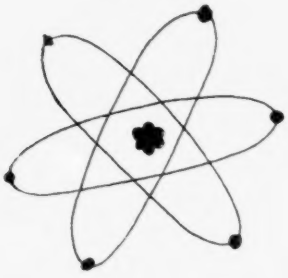
Petroleum

Natural Gas

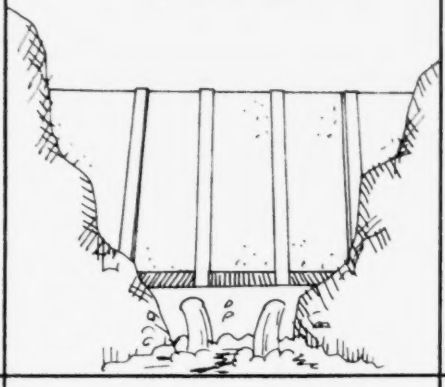


Coal

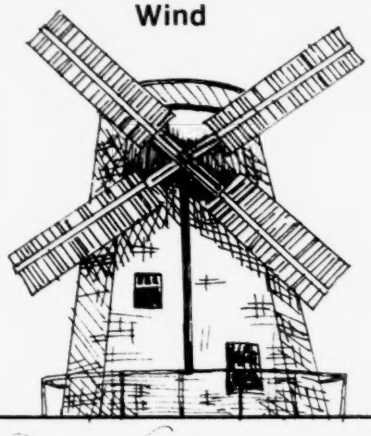
Nuclear

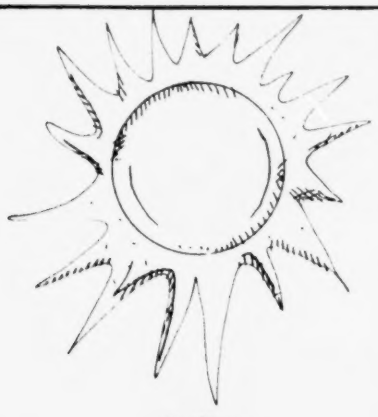


Hydroelectric



Wind





Solar

Wood

Geothermal

PRIMARY ENERGY SOURCES

Match the descriptions below of the primary energy sources to the pictures on page 3.

1. _____ A clean, efficient fossil fuel, second only to oil as an energy source in the United States.

2. _____ The primary source of all energy. Can be used to heat homes in solar cells and collectors.

3. _____ The splitting of the uranium atom unleashes great quantities of heat which can be used to provide electricity.

4. _____ Only a small portion of our power comes from plants in which falling water turns giant turbines. These plants can only be developed near large rivers where the building of dams is practical.

5. _____ This is a special type of solar energy created by the unequal heating of the earth's surfaces by the sun. It has limited usage and ways of storing this energy need to be developed.

6. _____ A solid fossil fuel composed mainly of carbon. It is now used mainly for the production of power in electrical power stations.

7. _____ Heat from the earth's center comes to the surface in geysers, volcanoes, and hot springs. This heat can be used for the generation of power only in limited areas where geysers are near.

8. _____ This energy source, while not used widely in the United States, is still common and important in many parts of the world.

9. _____ The most widely used energy source in the United States. Its molecule is composed mainly of hydrogen and carbon atoms.

PETROLEUM

Edwin Drake couldn't possibly have known what he started when he drilled the first oil well in Titusville, Pennsylvania, in the year 1859. Oil had been known before that event for thousands of years, but it was used only in limited ways, such as in lighting, cooking, and the waterproofing of ships. After 1859, the availability of oil greatly increased its demand. It soon became a necessity after the invention of the internal combustion engine and, in this country, by the introduction of Henry Ford's "Model T" car in 1910.

Although more than fifty percent of the petroleum consumed in this country is now used for transportation, it is also widely used for heating homes, supplying fuel for electric power plants, various industrial uses, and the manufacturing of petrochemicals. Petrochemicals refer to a great number of nonfuel products made from petroleum. These products include synthetic rubber, medicines such as aspirin, a great variety of plastics, detergents, solvents, textiles, paints, fertilizers, and construction materials.

Petrochemical products are made from the complex petroleum molecule. This molecule is called a hydrocarbon because it is composed mainly of hydrogen and carbon atoms. The variety of ways chemists have found to arrange the hydrogen and carbon atoms inside the petroleum molecule results in the hundreds of products made from petrochemicals. Without these products modern living would not be what it is today.

PETROLEUM

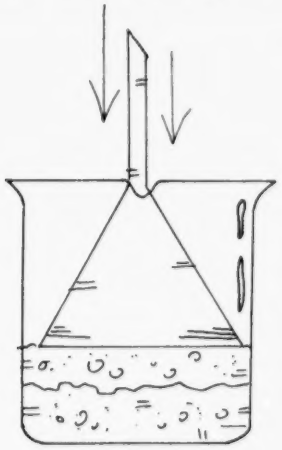
1. Who drilled the first oil well in the United States? When and where was it drilled?
2. Had oil been known and used before that time?
3. What were some of the earliest uses of oil?
4. What inventions made the drilling for more oil a necessity?
5. In addition to transportation, how is oil now used?
6. What are petrochemicals?
7. What products are made from petrochemicals?
8. What is a hydrocarbon?
9. How are different products made from hydrocarbons?
10. In what ways has petroleum changed the way people live?
11. If Edwin Drake had not drilled the first oil well, do you think someone else would have? Why or why not?
12. Do you think more uses will be found for oil in the future?
13. Where did the energy that is in oil originally come from?
14. Explain how that energy became oil.

LOOKING FOR OIL

Oil is found under certain conditions. When looking for oil, geologists look for certain conditions which are nature's clues. One of the clues is a type of rock called sandstone. Sandstone is porous; that is to say it has many small holes or pores. These pores act as a sponge to hold oil. Another clue is salt water. Oil was formed from the remains of prehistoric plants and animals which once lived in enormous swamps. These organisms died and in time were covered by large seas; the salt content of the seawater was important in keeping the organisms from decaying beyond a point at which petroleum is formed. In time another layer of rock, called shale, formed and kept the oil and water from escaping to the surface. Geologists know that when these three conditions (sandstone, salt water, and shale) exist, the chances for locating oil are good. To make a model of these conditions you will need the following:

MATERIALS: Funnel, beaker or jar, water, scissors, and sponge.

PROCEDURE: Select a funnel which fits the inside of the beaker or jar. Cut circles of the sponge to fit the beaker. Layer the circles in the beaker. Saturate the sponge with water. Press the funnel upside down into the sponge.



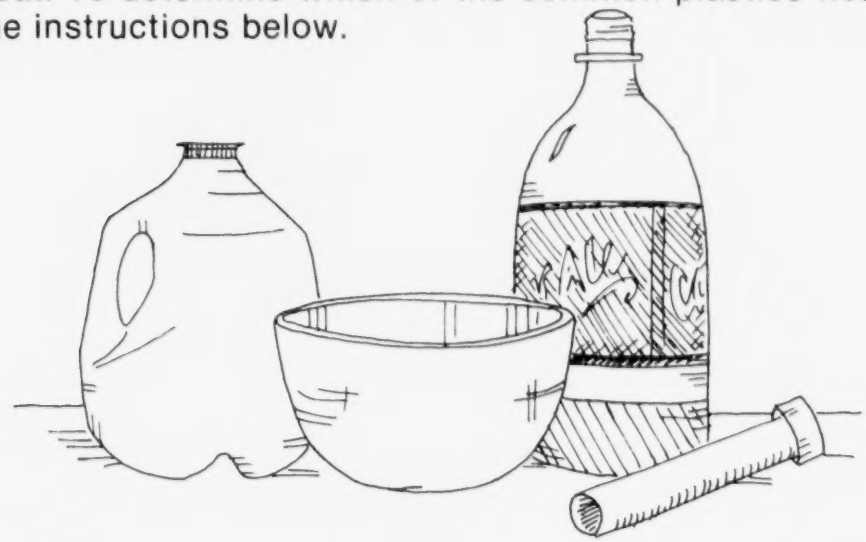
QUESTIONS:

1. The sponge represents _____ rock.
2. The water represents _____.
3. The wide part of the funnel represents _____ rock.
4. The tube of the funnel represents the _____.

IDENTIFYING PLASTICS

We live in a world of plastics. Many natural materials, such as wood, metal, and glass are now replaced by plastics. If you look around, you will be able to readily identify clothes, pens, desks, wallets, shoes, and other things made mostly of plastic.

The three major types of plastics we use daily are polyethylene, polystyrene, and polyvinyl chloride. In order to tell the difference between these three types of plastics, you will have to do some tests. One of these tests is the floating test. All plastics do not float. To determine which of the common plastics float, follow the instructions below.



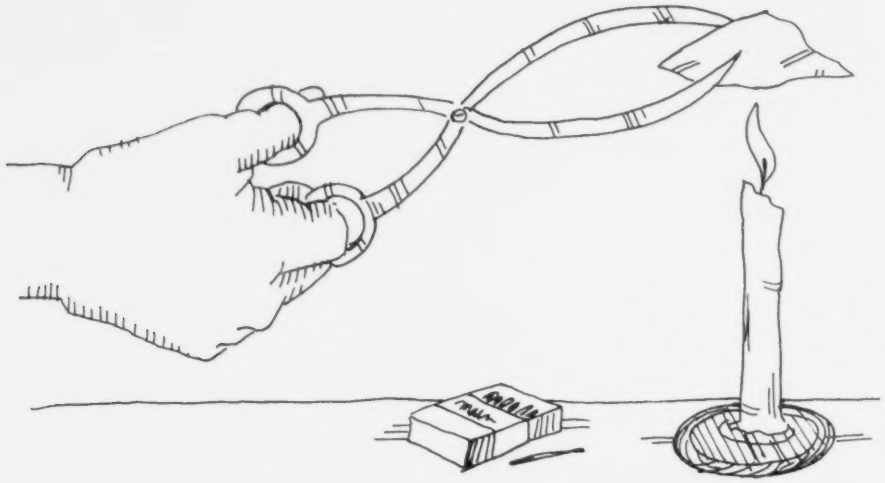
MATERIALS: Pieces of three types of plastic—a piece of a white milk jug, a piece of clear plastic such as you would find in a large soft drink bottle, and a piece of black or white PVC pipe.

PROCEDURE: In a large bowl or beaker, place a piece of each type of plastic on the surface of the water. Record the results below.

MATERIAL	FLOATS	SINKS
milk jug		
clear plastic		
PVC pipe		

IDENTIFYING PLASTICS

Another way to distinguish between different plastics is to do a burning test.



MATERIALS: Another piece of each of the three plastics used on page 8 about one-inch square, candle, matches, and long tongs.

PROCEDURE: Using long tongs, carefully hold each piece of plastic over the candle flame. Watch for a change in the color of the flame, notice whether or not the plastic drips, the presence of an odor, and whether or not it continues to burn after it is removed from the flame. Record your observations in the spaces below.

MATERIAL	COLOR OF FLAME	DRIPS		ODOR		BURNS AFTER REMOVED FROM FLAME	
		YES	NO	YES	NO	YES	NO
Milk jug							
Clear plastic							
PCV pipe							

To identify the plastics, compare your results with the information at the top of the next page.

IDENTIFYING PLASTICS

Polyethylene burns with a blue and yellow flame. It drips when it burns and smells like wax. It continues to burn when it is removed from the flame. It floats in water. Example: milk jug.

Polystyrene burns with a yellow flame. It drips when it burns and has an odor similar to gas. It continues to burn when it is removed from the flame. It does not float. Example: clear plastic from soft drink bottle.

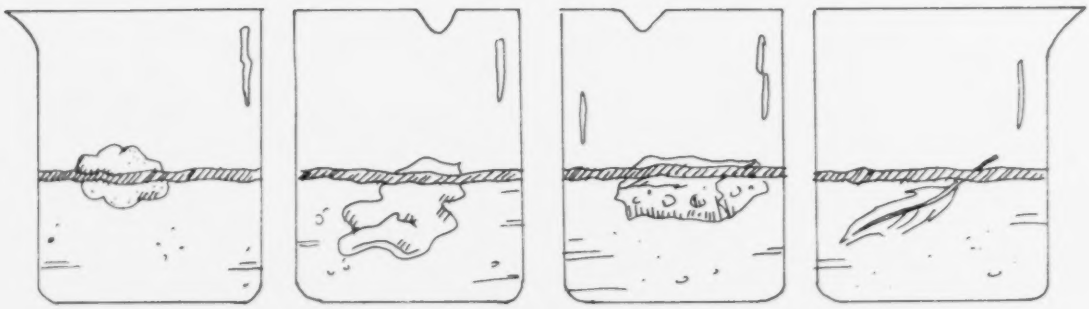
Polyvinyl chloride burns with a yellow and green flame. It does not drip and does not continue to burn when it is removed from the flame. It has a strong odor and it does not float. Example: PVC pipe.

QUESTIONS:

1. Look up the word plastic in a dictionary. What does it mean? From what Greek word does it come?
2. What are three types of plastics?
3. List ten common items once made of natural materials and now commonly made of plastic.
4. Many plastics are better suited for some purposes than the natural products they replaced. Give at least one example and tell why it is so.
5. Give an example of an item made of plastic which does not work as well as one made of a natural product.
6. Design something to be made of plastic. Tell what qualifications the plastic would have to have in order to make your product a good one, for example, flexibility, strength, lightweight, etc.
7. What are some things you prefer to have made from natural materials?

WHICH MATERIAL ABSORBS OIL BEST?

Seeking new places to find oil has resulted in drilling for oil under ocean water. This is usually referred to as offshore drilling. Because of the difficulties of this type of drilling, oil spills sometimes occur. Oil spills are also the result of accidents with large ocean going tankers that transport oil. To prevent serious environmental damage, new ways of cleaning up oil spills are being studied. To test some common materials and their abilities to absorb oil from water, do the following experiment:



MATERIALS: Four large beakers or jars, water, motor oil, feathers, cotton, cloth, sponge, and any other material you may wish to test. (You will need more jars if you test other materials.)

PROCEDURE: Measure the same amount of water into each beaker, about two or three cups. Pour one-half cup of oil into each beaker. Saturate one material in each beaker overnight. Examine the results the next day.

WHICH CLEANS BETTER, SOAP OR DETERGENT?

MATERIALS: Laundry soap, laundry detergent, measuring cup, two one-gallon jugs with caps, scissors, and a dirty rag.

PROCEDURE: Fill the gallon jars three-fourths full of warm water. Add one-fourth cup of detergent to one jar and one-fourth cup of laundry soap to the other. Cut the dirty rag into two equal parts and put one piece of the rag in each jar. Cap the jars and shake. Allow to soak overnight. Remove the rags and rinse well in warm water. Twist out excess water and compare.

VARIATIONS:

1. Compare different brands of detergents or different brands of soaps to each other. Use the procedure given above.

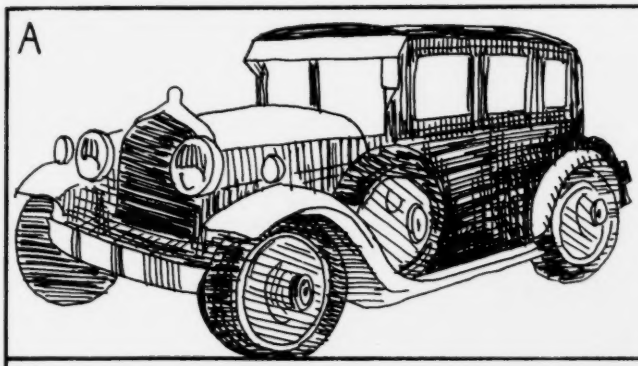
2. Compare the same detergent in different temperatures of water.

3. Epsom salts makes water hard. Rainwater or distilled water is soft. Make a comparison of the same detergent or soap in hard and soft water.

CAR DESIGNS

In the United States more than fifty percent of the energy that comes from petroleum is used for transportation. Much of this is used by automobiles. There is no doubt that we are dependent upon automobiles to maintain our style of living. Below are drawings of American automobiles. Can you determine by the design the dates in which these cars were popularly used?

A



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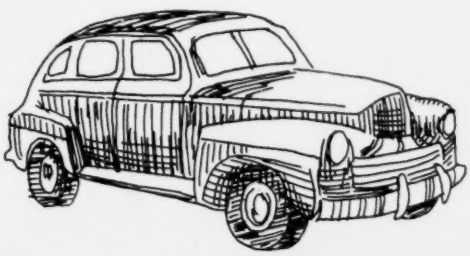

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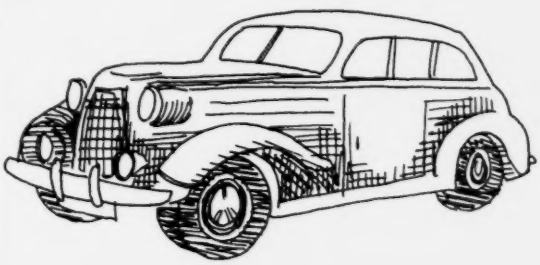

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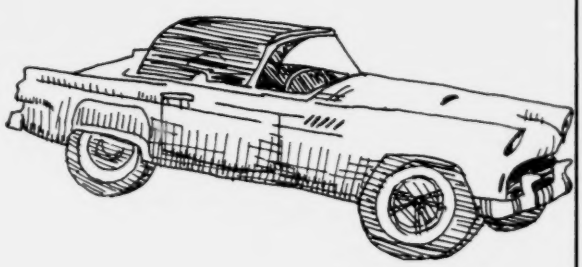

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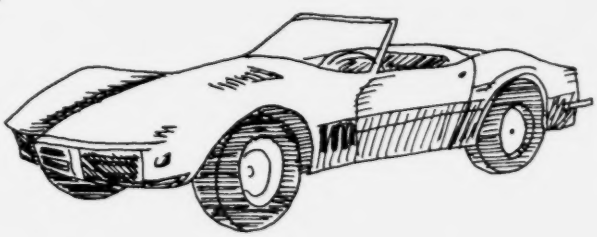

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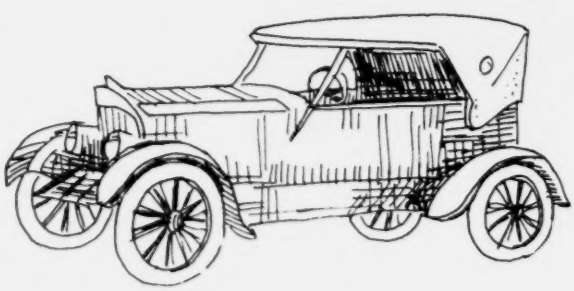


1. _____ 1910's
2. _____ 1920's
3. _____ 1930's
4. _____ 1940's
5. _____ 1950's
6. _____ 1960's

DESIGNING CARS

Cars are designed by automotive engineers. First they are drawn on paper; later models are made to be tested. After the models are thoroughly tested, production may begin in an automotive factory. Engineers who design cars must work within certain limits to control cost, speed, gas usage, etc. These limits are called parameters. In the space below make your own car design of the future. Observe the following parameters:

1. Your car design must not be longer than six inches.

2. The car must have four wheels. You do not have to show all four wheels on your drawing if the car is drawn from the side view.

3. Your car design must not be more than four inches in height.

4. The steering wheel on your car must be on the left-hand side.

COAL

Coal is a black or brownish-black rock that burns. It is, like oil and natural gas, a fossil fuel. By that we mean that it was formed over a period of millions of years from the remains of plants and animals. In addition to being solid, it differs from oil and natural gas because it is composed mostly of carbon.

Over two hundred million years ago, vast swamps rich with ancient plant life flourished over much of the earth's surface. As the plants died their remains fell to the bottom of the swamps. New growth soon reappeared on the fertile remains of the old. This regrowth reoccurred for millions of years. In time ancient seas covered much of the land and deposited sediments. These sediments gradually changed into rock, producing heat and pressure, which transformed the plant remains trapped below into peat and later into coal.

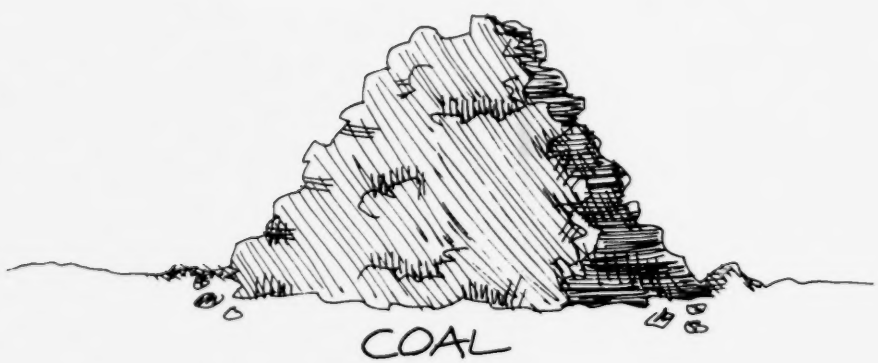
Today coal is our most abundant fossil fuel, but it ranks only third as a supplier of energy. It is not widely used due to the cost of mining and its impurities which cause pollution. Coal was once widely used for heating homes in the United States, but it has been largely replaced by natural gas and oil. Today it is used mostly in providing the fuel for electric power plants.

There are basically two ways of mining coal. The first way is underground mining where miners dig tunnels to reach beds of coal. The second is surface or strip mining. Top layers of earth and rock located close to the surface are removed exposing the layers of coal. Environmental problems and destruction of the landscape add to the cost and criticism of strip mining.

New ways of using coal are being explored. One such way is coal liquification. This is a method in which coal molecules that are mainly carbon are changed into hydrocarbon molecules similar to oil in looks and usage.

COAL

1. What is coal?
2. What are fossil fuels?
3. Name two other fossil fuels besides coal.
4. How was coal formed?
5. Why are the uses of coal limited?
6. How is coal used today?
7. What are two ways of mining coal?
8. Describe the two ways in which coal is mined.
9. Which is the more dangerous way?
10. What is coal liquification?
11. How does coal rank as a supplier of energy in the United States?
12. How does coal rank as a fossil fuel in untapped supplies?



THE EFFECTS OF AIR POLLUTION ON NYLON

Air pollution is a problem in areas where large industries burn fossil fuels, such as coal. Coal releases large amounts of sulfur into the air when it is burned. Sulfur in the atmosphere is easily joined to oxygen and water vapor to form many dangerous pollutants such as sulfuric acid. Sulfuric acid and other sulfur compounds can easily damage paint, metals, rocks, paper, and fabrics, as well as vegetation and animal life.

To show how fabrics are attacked by pollutants, set up the following experiment:

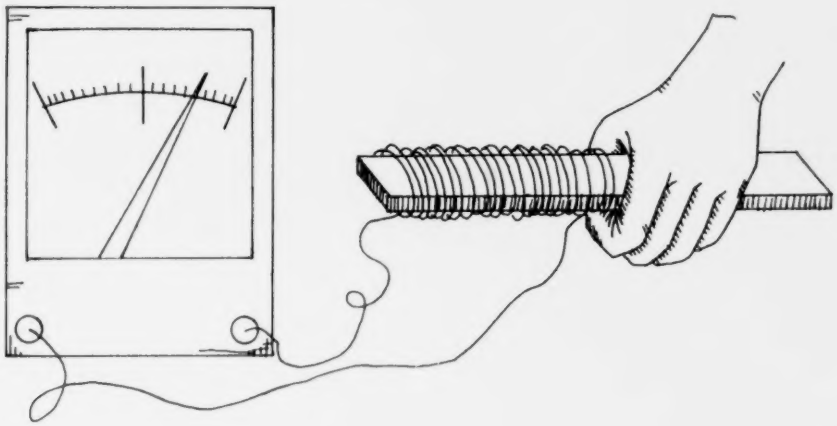
MATERIALS: Wide mouth jar, magnifying glass, rubber bands or string, nylon stocking, and scissors.

PROCEDURE: Cut out an undamaged section of the nylon stocking and stretch it over the mouth of the jar. Fasten it with rubber bands or string. Use a magnifying glass to check the stocking for damage. Set the jar outside in an open spot. Allow the jar to remain outside for a month. Examine it again for damage or breaks. If the stocking shows no breaks, it may indicate little chemical pollution. More than six breaks indicates heavy chemical pollution.

QUESTION: Laws have been passed to keep industries from polluting the air and water. How do you feel about such laws?

PRODUCING AN ELECTRIC CURRENT

To show how large generators make electricity in electric power plants, follow the procedure below.

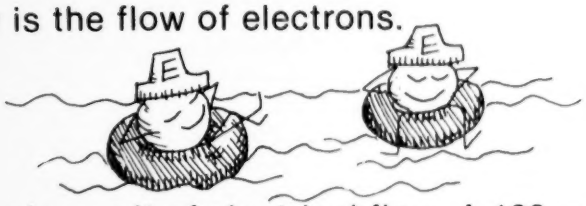


MATERIALS: A galvanometer (this is a device that measures the pressure of an electric current), cardboard tube, copper wire, and a bar magnet.

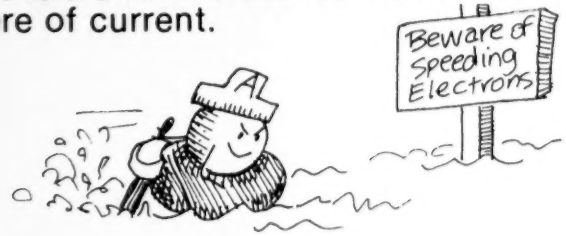
PROCEDURE: Wrap the copper wire around the cardboard tube about thirty or forty times. Remove the tube. Connect the ends of the wire to the galvanometer as shown above. Move the bar magnet in and out of the wire coil. Notice what happens to the needle. Of course, electricity in power plants is more complex, but the principle is the same. Three things are needed: magnets, wire, and movement. The movement of giant magnets is supplied by special wheels called turbines. These turbines are turned by water power or steam heated by coal, oil, or atomic energy.

ELECTRICAL TERMS

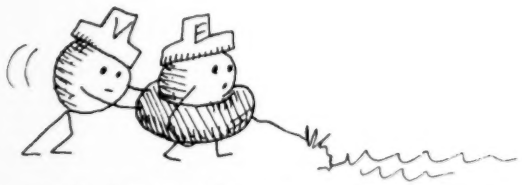
Electricity is the flow of electrons.



An ampere is a unit of electrical flow. A 100-watt lamp bulb uses one ampere of current.

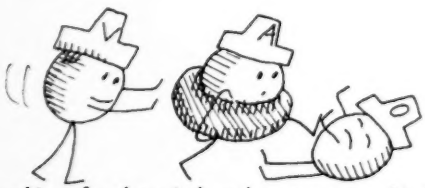


A volt is a unit of electrical pressure that pushes the electrons along.

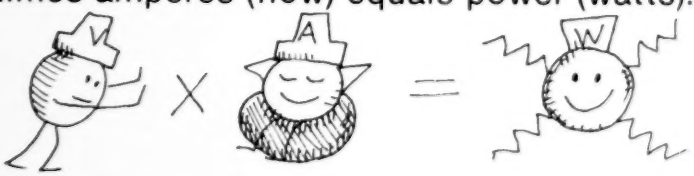


An ohm is a unit of resistance to the current flow.

It takes one volt of electricity to overcome one ohm of resistance in order for one ampere to flow.



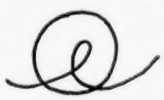
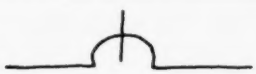
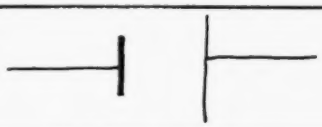
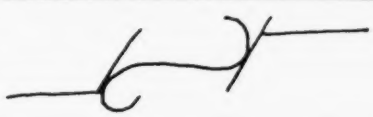
A watt is a unit of electrical power. It is a combination of volts (pressure) times amperes (flow) equals power (watts).



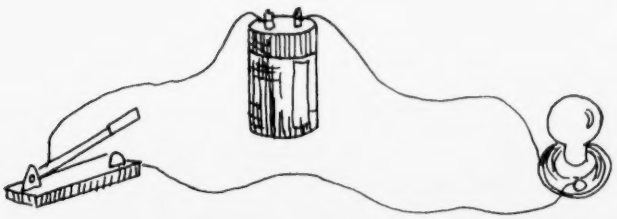
A kilowatt is 1,000 watts.
A megawatt is 1,000,000 watts.
A kilowatt hour measures how much electrical power is used over a given period of time.

READING ELECTRICAL SYMBOLS

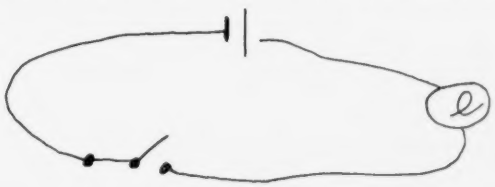
Scientists, engineers, and electricians often use symbols in place of words. See how many of the symbols below you can match to their electrical terms.

1. Wire ____	a.
2. Fuse ____	b. 
3. Switch ____	c.
4. Generator ____	d.
5. Resistance ____	e.
6. Bulb ____	f.
7. Dry cell ____	g. 
8. Wire crossing another wire not connected ____	h.
9. Wires connected ____	i. 
10. Receptacle ____	j. 

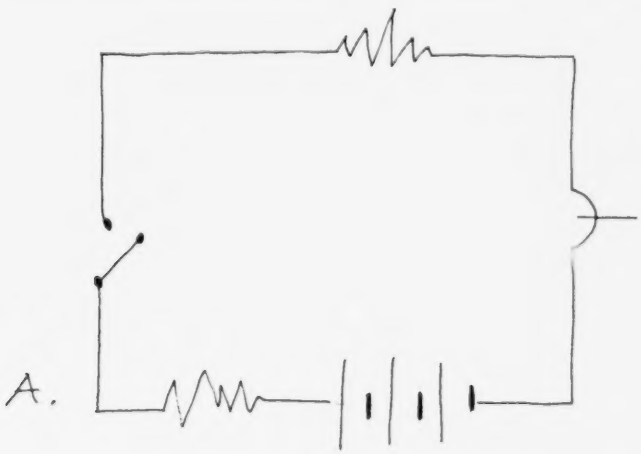
READING ELECTRICAL DIAGRAMS

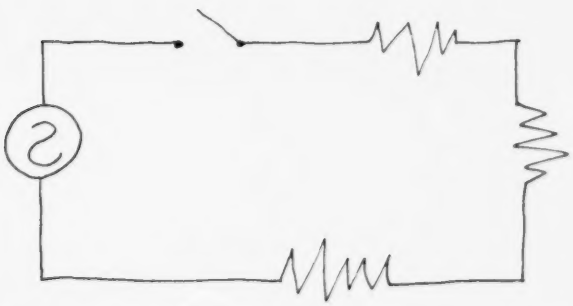


The circuit above contains a dry cell, bulb, and a switch. The same circuit is represented below using electrical symbols.



With the help of the electrical symbols on the preceding page, see if you can read the diagrams below.

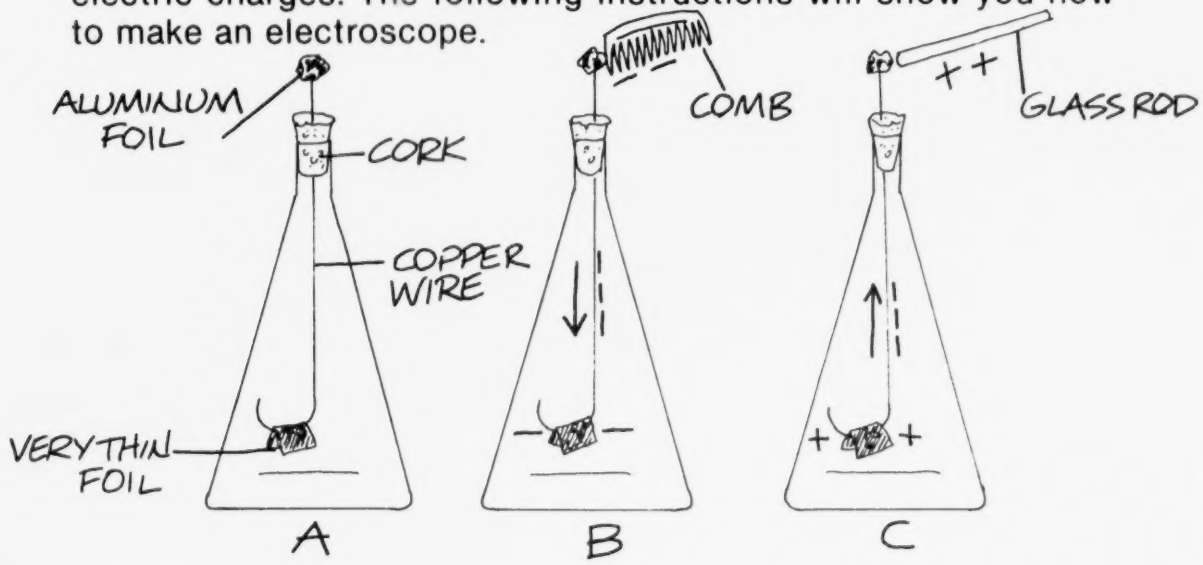




In the space below make an electrical drawing of your own.

MAKE AN ELECTROSCOPE

An electroscope is an instrument which will help you understand electric charges. The following instructions will show you how to make an electroscope.



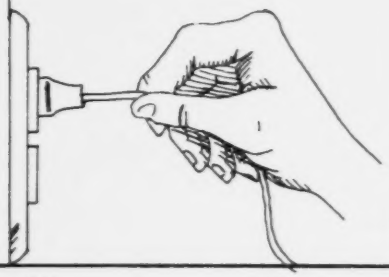
MATERIALS: Jar or flask with tight-fitting cork stopper, copper wire, very thin aluminum foil, aluminum foil, and scissors.

PROCEDURE: Assemble your electroscope as shown above in diagram A. In the best electroscopes, gold leaf is used for the leaves inside the jar. Since this is not readily available, get the thinnest aluminum foil you can—foil from a gum wrapper with the paper liner peeled off works well. To make your electroscope work, run a comb through your hair several times. Touch the comb to the knob on the top. Observe what happens to the leaves. When the negatively (–) charged comb touches the knob, it repels electrons, causing them to flow to the leaves as in diagram B. Both leaves become negatively charged and since like charges repel, the leaves will separate. If you touch the knob with a positively charged (+) object, such as a glass rod which has been rubbed with silk as in diagram C, the results will be the same. In this case, some of the electrons (-) in the leaves will be attracted to the positively charged (+) rod. They will travel upward to the rod leaving two positively charged (+) leaves. The leaves will repel each other and fly apart.

ELECTRICAL SAFETY

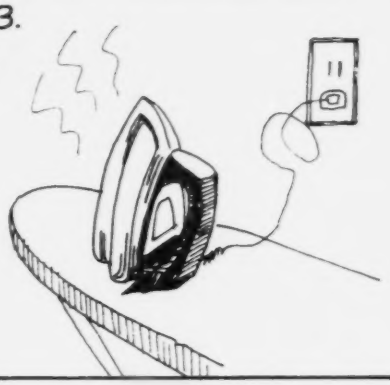
All of the pictures below depict hazardous electrical situations. Can you identify the dangers and tell how they can be corrected?

1.

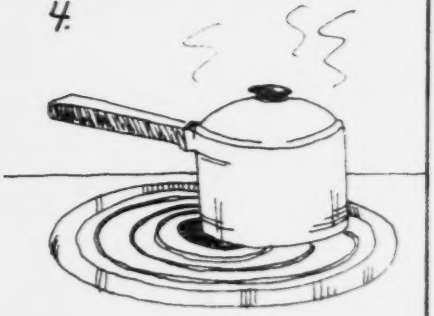


2.

3.



4.



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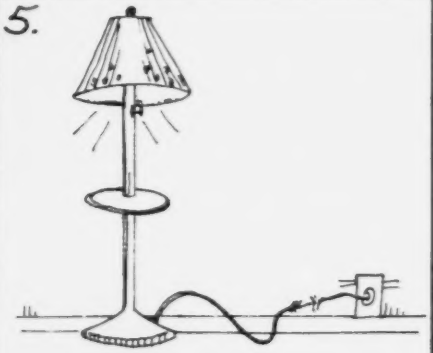

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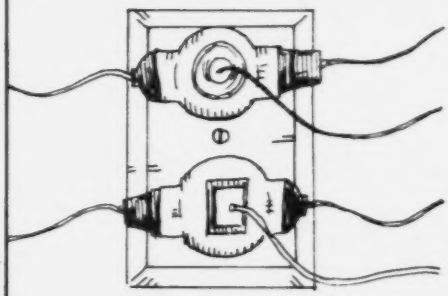

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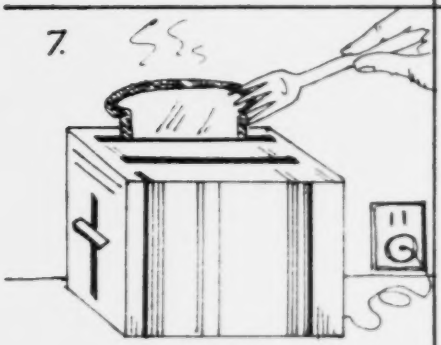

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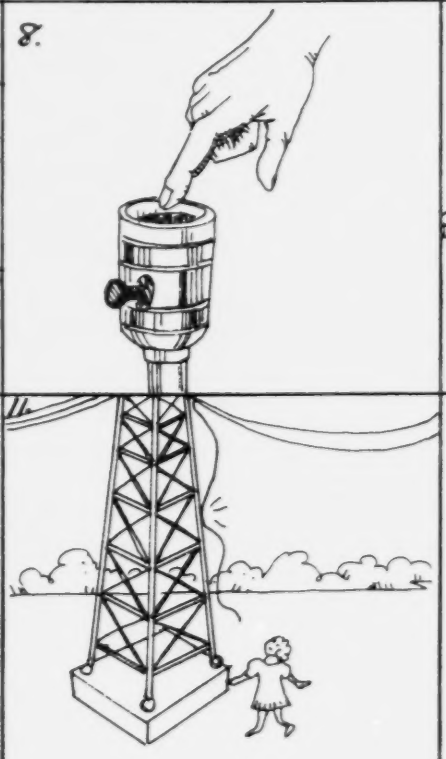
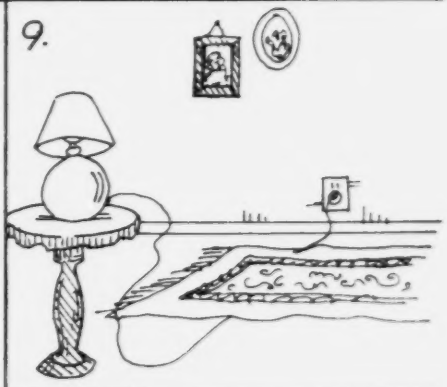


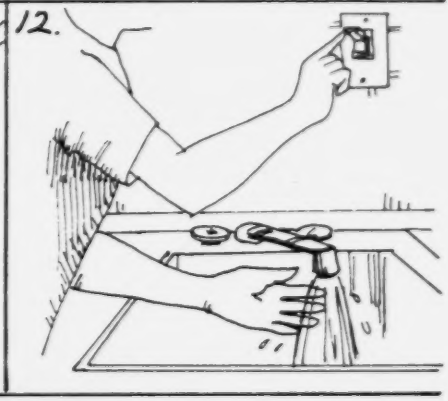
9.



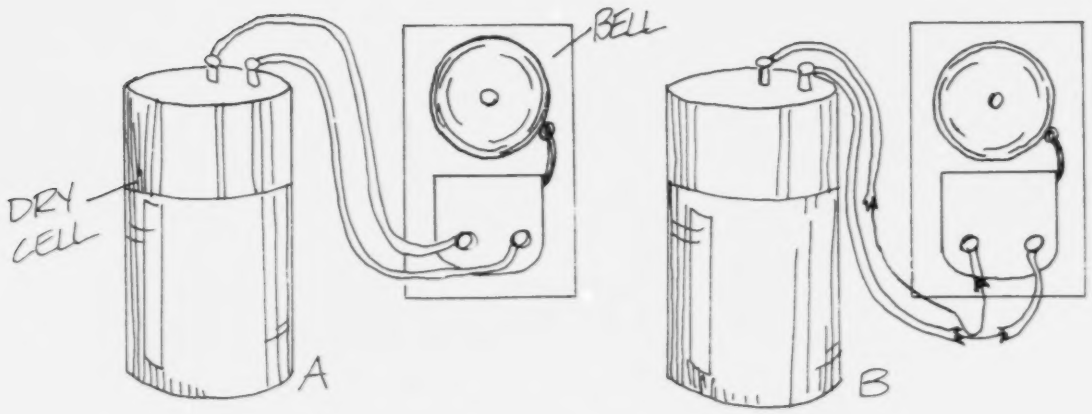
10.

11.

12.



WHAT ARE CIRCUITS AND SHORT CIRCUITS?



MATERIALS: Copper wire, electric bell, and dry cell.

PROCEDURE: Remove the insulation at the ends of the wire. Connect to the bell as shown above in drawing A. The dry cell supplies electricity, the wires are conductors that carry the electricity, and the bell converts the electricity into mechanical and sound energy. To make a short circuit, remove some insulation from the wires as shown in drawing B. Bring the wires together at the place where the insulation was removed.

QUESTIONS:

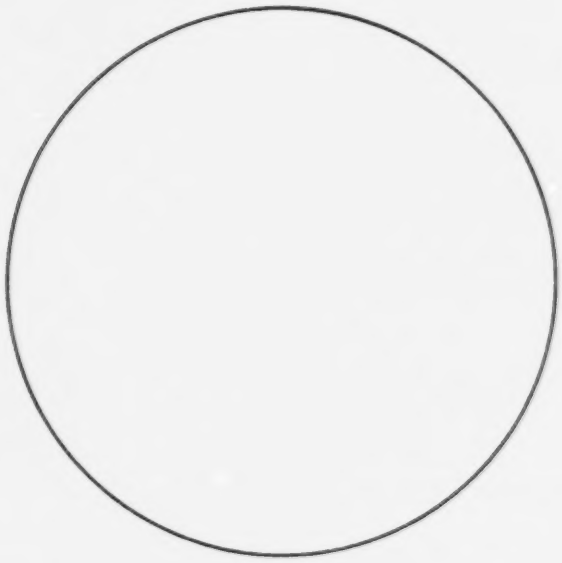
1. Circuit refers to a circle. Why do the terms *circuit* and *short circuit* apply to the above diagrams?

2. Why did the bell ring in the circuit and not in the short circuit?

USES OF ELECTRICAL ENERGY

Modern living would be difficult without electrical energy. Many of the conveniences we enjoy today would be impossible without electricity. Electrical energy is used in these four major ways:

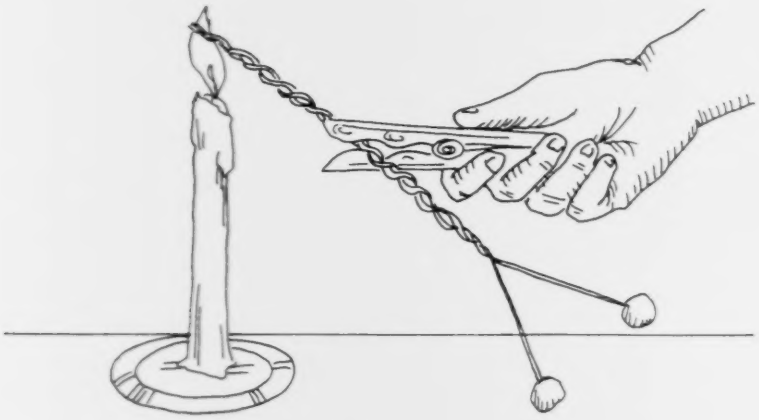
Lighting	4%	Lights for streets, highways, etc.
Residential	32%	Lighting, heating and cooling of houses (residences), home appliance uses.
Industrial	42%	Factories and places where products are made.
Commercial	22%	Restaurants, stores, banks, hospitals, etc.



To see at a glance the uses of electrical energy, use the above figures to make a circle graph. You may make your graph by estimating the percent of the graph for each use, but if you want your graph to be accurate, use a protractor. First, convert percent into degrees by multiplying each percent by 3.6. Thus 4% becomes 14.4 degrees. Measure off 14.4 degrees on the circle with your protractor, and label this part of the graph "Lighting for Streets and Highways." Convert the other percentages into degrees in the same way.

WHICH WIRE IS THE BETTER CONDUCTOR OF HEAT?

To show that various metals conduct heat at different rates, do the experiment as directed below.

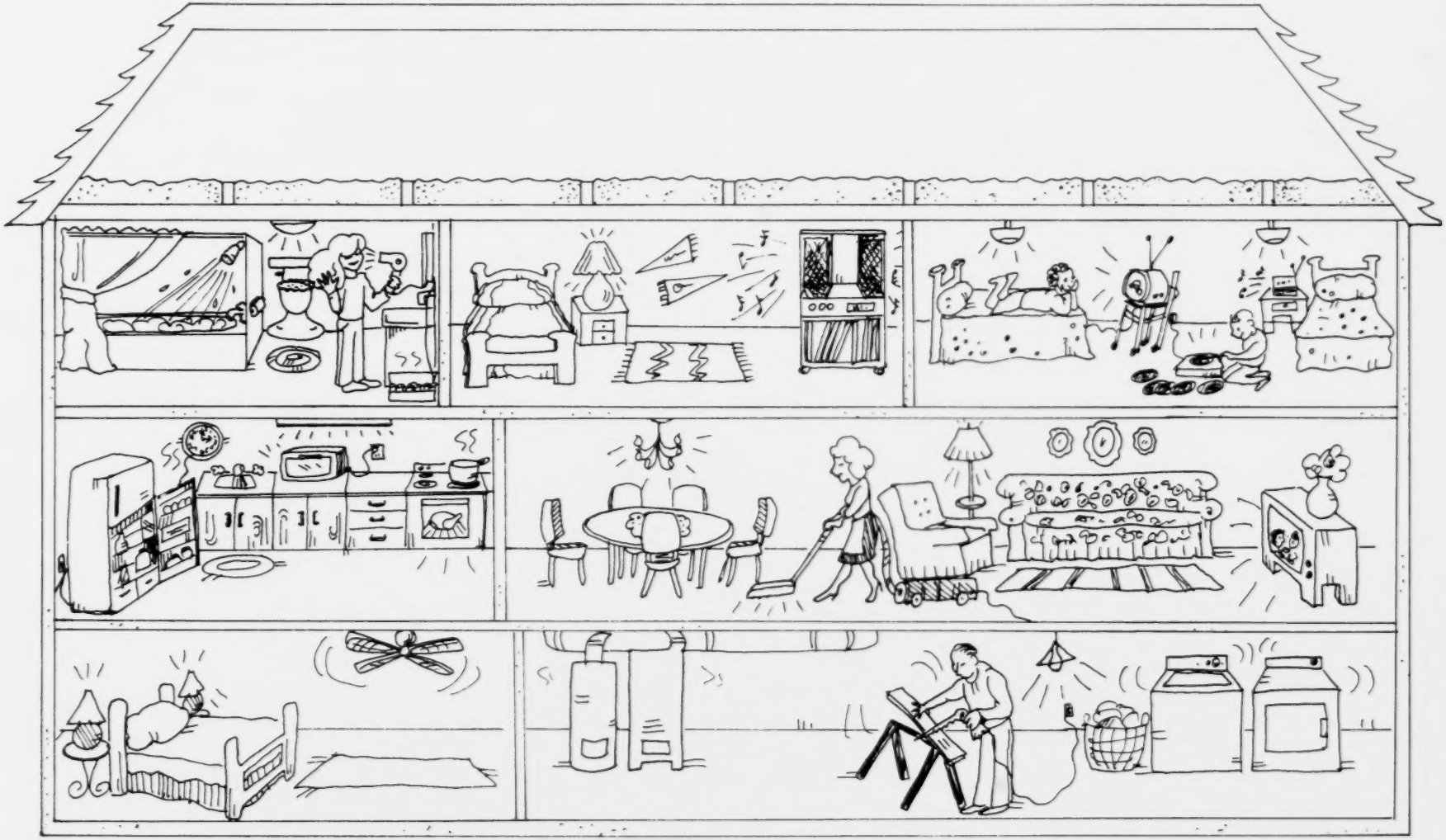


MATERIALS: Copper wire, iron wire or another metal wire the same size as the copper wire, candle or Bunsen burner, matches, wax, and a wooden clip-type clothespin.

PROCEDURE: Loosely twist three-inch lengths of copper and iron wire as shown above. Form two small balls of wax and press into the ends of the wires. Use the clothespin to hold the opposite ends of the wires in the flame. The wire which melts the ball of wax first is the better conductor of heat. Some good conductors of heat are gold, silver, copper, and aluminum. Substances which do not conduct heat well are called insulators. Glass, ceramics, stone, water, and air are good insulators.

ENERGY IN THE HOME

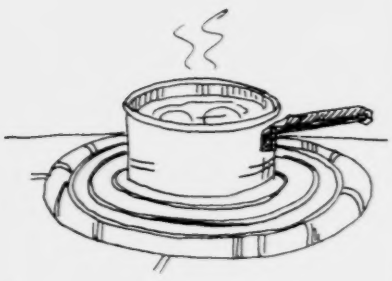
Do you ever stop and think of the many ways in which electrical energy is used in our homes? Life as we know it today would be impossible without our many electrical appliances. Circle all the things in the house below that use electricity.



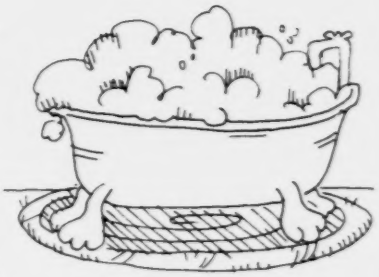
What electrical appliances can you think of that are not in the picture? Either add them to the drawing or list them.

WASTING ENERGY

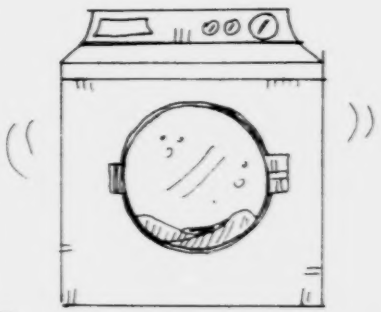
Can you determine how energy is being wasted in each picture below? On a separate sheet of paper, tell how energy is being wasted and give ways to correct each situation.



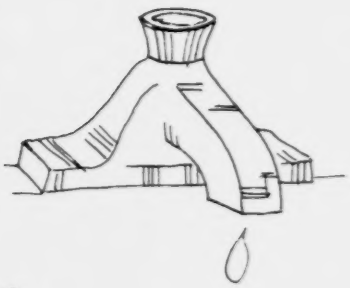
1.



2.



3.



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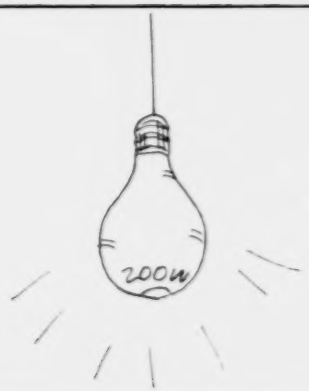

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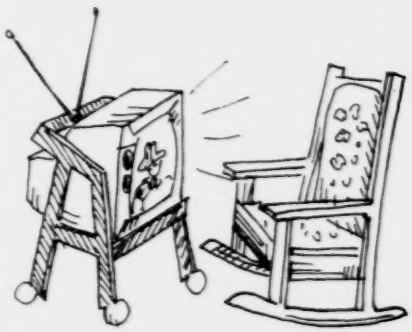

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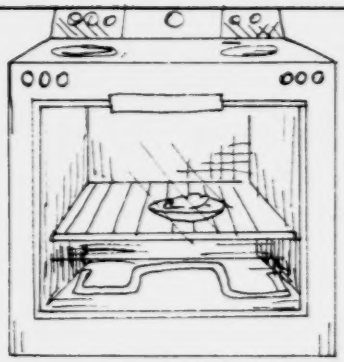

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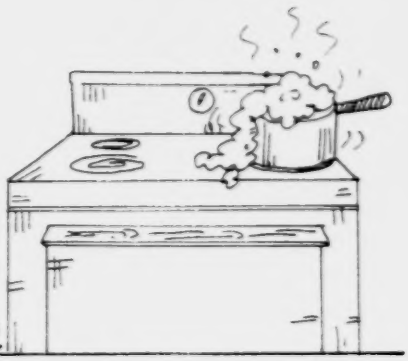

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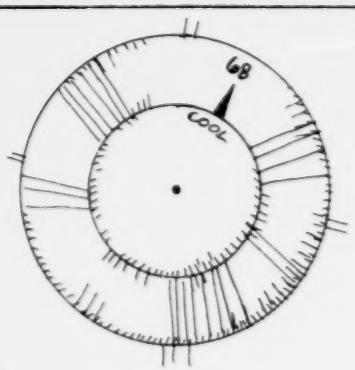

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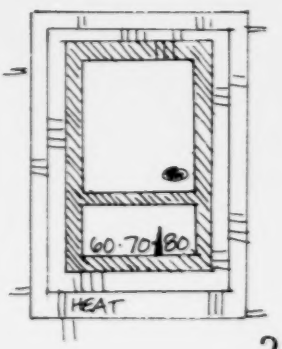

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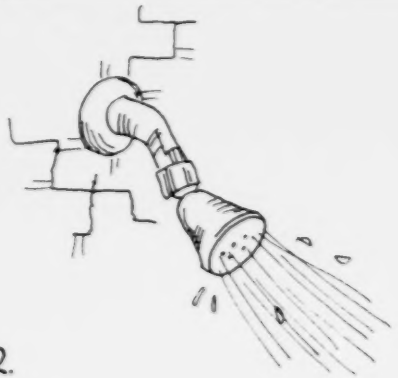
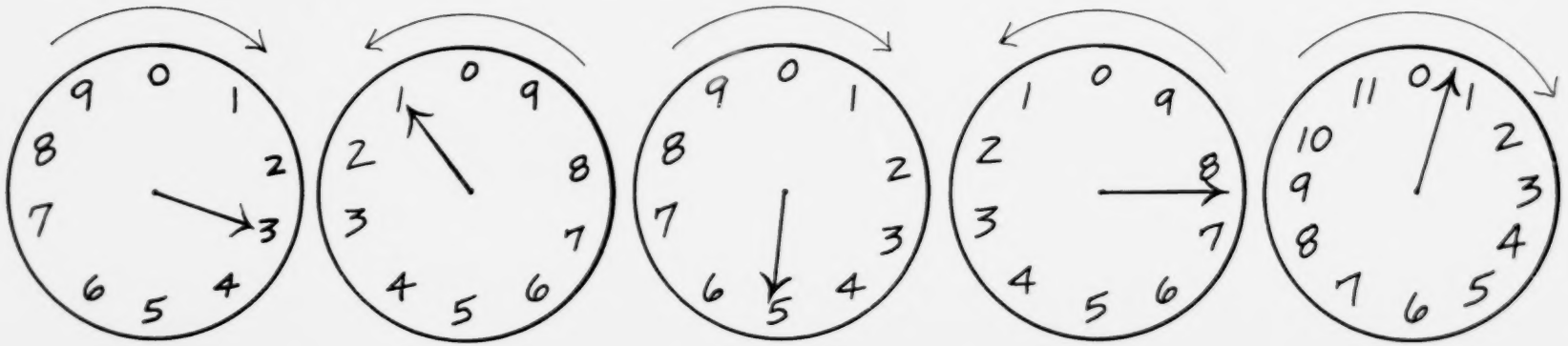


12.

33

HOW TO READ AN ELECTRIC METER

Your electric meter looks something like the pictures below. The pointers on the dials show the number of kilowatt hours of electricity used since the meter was installed. Electric meters are read from right to left and the numbers are recorded from right to left. The first meter on the right counts in single kilowatt hours, the second in units of 10 kilowatt hours, the third in 100 kilowatt hours, the fourth in 1,000 kilowatt hours, and the fifth in units of 10,000 kilowatt hours.



Read and record the above meters from right to left. It reads _____ kilowatt hours. To get the kilowatt hour usage for a particular month, subtract the previous month's reading from the current month. If the above reading is for the month of July and June's reading was 29,440 kilowatt hours, what is the kilowatt hour usage for July? _____.

VARIATION: The students or teacher may wish to make model meters for display by using paper plates, fasteners, and moveable pointers.

NATURAL GAS

Do not confuse natural gas with gasoline, the liquid fuel widely used in automobiles. Natural gas is a gas made largely of methane. The chemical formula for methane is CH_4. This means that one molecule of methane contains one atom of carbon and four of hydrogen. Natural gas, like coal and oil, is a fossil fuel and was formed in a similar way. Millions of years ago, an enormous number of prehistoric plants and animals lived and died. Their remains in time formed layer upon layer of compressed material. These layers are called organic matter because they originated from living organisms. In time other sediments were deposited and changed into rock, trapping the organic remains below. The organic material under the sedimentary rock slowly decayed forming hydrocarbons, such as oil and gas. The gas formed from the decaying organic material became trapped in spaces under the sedimentary rock. When holes are drilled through the rock into these spaces, natural gas is obtained for our usage.

In this country drilling for natural gas began in 1821 in Fredonia, New York, when William A. Hart became fascinated by a burning creek. It was in this creek that he dug the first well for natural gas using hollow logs for pipes. He covered his well with an iron plate and used the gas he collected for lighting gas lamps. Later he used natural gas to illuminate a lighthouse on Lake Erie. From this beginning, others came to dig deeper wells and by the year 1858 the first natural gas company in this country, The Fredonia Gas Light Company, was formed. Today, natural gas is widely used as an energy source in our homes for heating, cooking, washing, and drying clothes along with many other uses. Like petroleum, it is also used as a raw material in the production of petrochemicals. The major use of natural gas, however, is to supply energy to industries such as bakeries, dairies, china and brick factories, as well as hundreds of other factories which require heat in the making of their products. In addition to these existing demands, new uses for natural gas are being developed almost daily.

QUESTIONS

1. What is natural gas?

2. What is the formula for methane? What does this formula mean?

3. How was natural gas formed?

4. What type of rock is looked for when seeking deposits of natural gas?

5. Under what circumstances was the first gas well in the United States dug?

6. When and where did this happen?

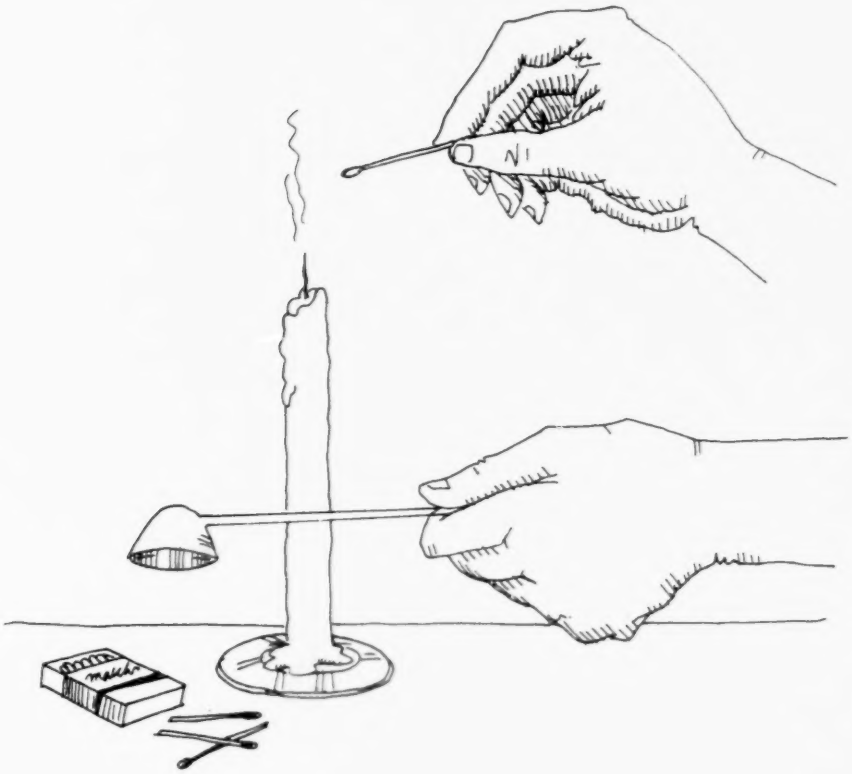
7. What were some of the early uses of natural gas?

8. What are some ways we use natural gas in our homes today?

9. What is the major use of natural gas?

10. How do you think natural gas will change our lives in the future?

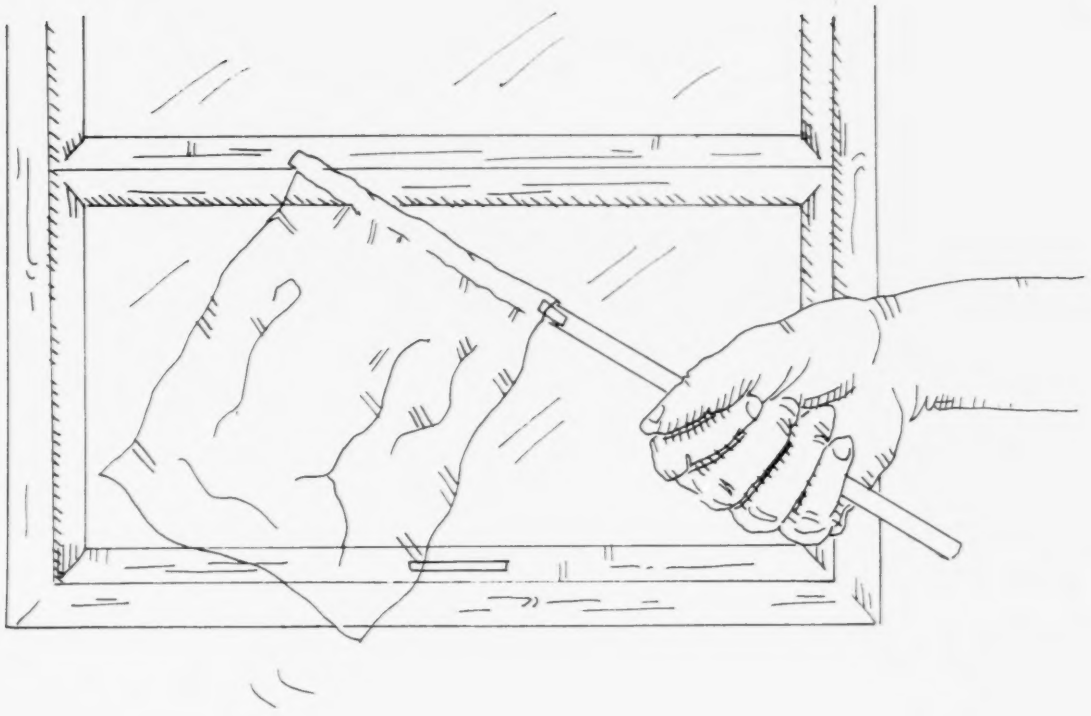
KINDLE AN INVISIBLE GAS



MATERIALS: Candle, candlesnuffer, and matches.

PROCEDURE: Select a place to do your demonstration away from drafts or air currents. Use a match to light a candle. Put out the match and allow the candle to burn a few seconds until the flame is high and straight. Light a second match and hold the candlesnuffer in the opposite hand. Use the candlesnuffer to gently put out the candle. Remove the candlesnuffer and quickly bring the lighted match to within one-half inch above the wick. Gas escaping from the extinguished candle will quickly relight it without the match touching the wick.

MAKE A DRAFTMETER



A draftmeter is a device that measures currents which cannot be seen. It is helpful in detecting places in homes where cold air (drafts) is seeping in around windows and doors.

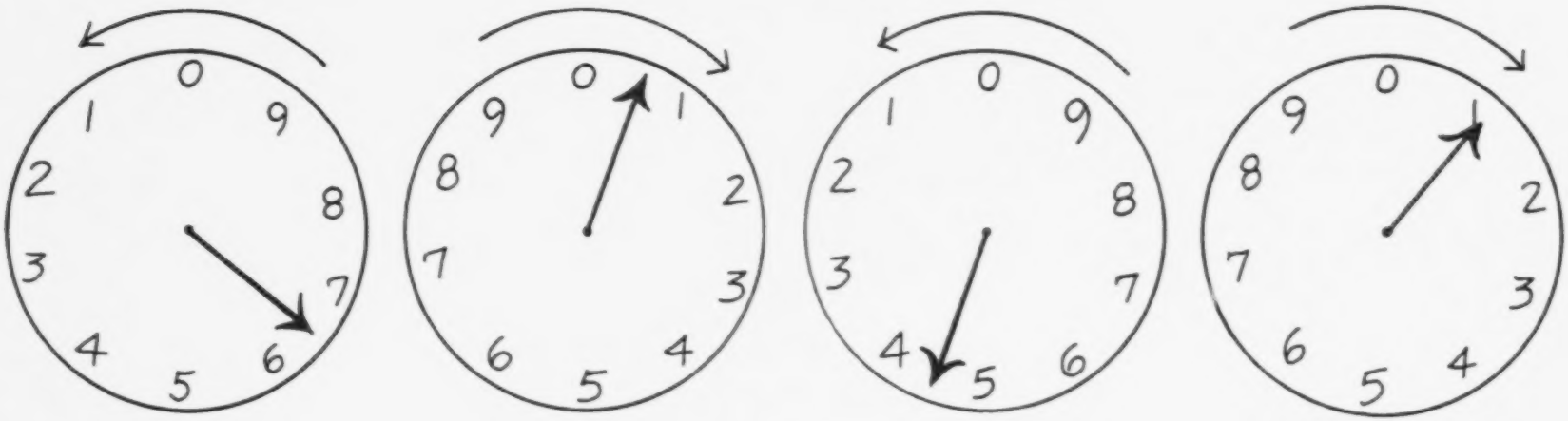
MATERIALS: Dowel or pencil, Saran Wrap, and tape.

PROCEDURE: Tape a ten-inch piece of Saran Wrap around a pencil or dowel. If you use a pencil, cut out the Saran Wrap so that you can use part of the pencil as a handle.

Use your draftmeter in different places. It should be able to detect the slightest movement of air.

HOW TO READ A GAS METER

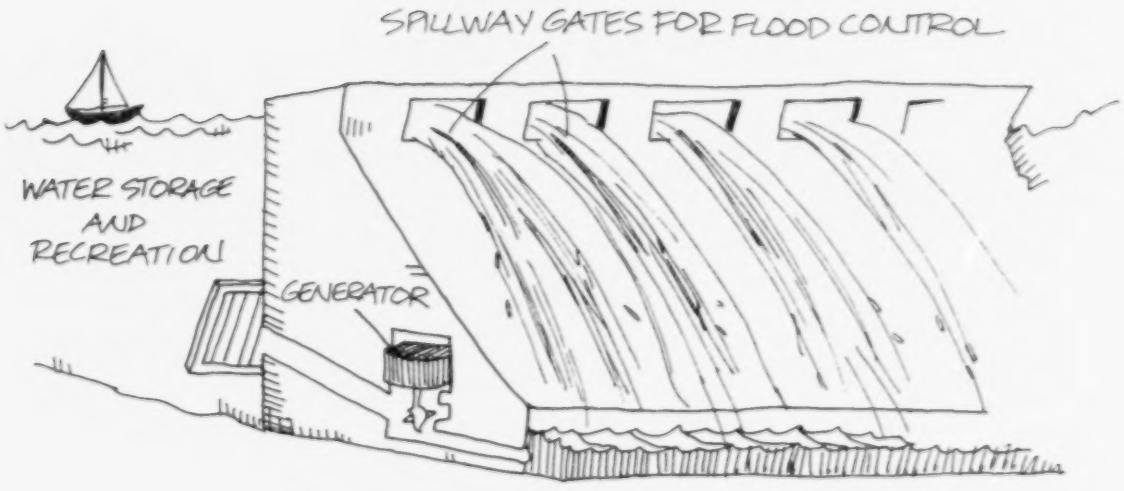
Gas meters measure gas usage in cubic feet. Gas meters are read much the same as electric meters. To read the meter below, record the last number passed by the pointer. Notice that the pointers of gas meters run in the opposite direction than that of electric meters. Record the numbers, reading the dials from left to right; then add two zeros to the number. You will have a meter reading of gas consumption in cubic feet. What is your reading? _____ cubic feet. If this reading is for the month of July and the reading for the month of June was 599900, subtract June's reading from July's to find the actual amount of gas used in the month of July. What is July's usage? _____ cubic feet.



HYDROELECTRIC POWER

Early man learned many thousands of years ago to store water for drinking and irrigation in simple dams. Today we are still building dams for those same reasons and many other new ones. One of the most important uses of dams in modern times is for the creation of energy. The enormous power of falling water is capable of turning giant turbines. These turbines drive the generators which produce electricity for homes, businesses, and industries. The degree of power is determined by the amount of water and the distance it falls. The larger the amount of water and the greater the distance of the fall, the greater the amount of electricity produced.

Strictly speaking, hydroelectric power comes from the sun, for it is the energy of the sun which each year evaporates an estimated 100,000 cubic miles of water in the form of water vapor from the oceans, rivers, streams, and lakes. This moisture later returns to the earth as precipitation. When this water collects behind dams on large rivers, it provides a source of power. Dams are also valuable in controlling floods and for recreational purposes.



HYDROELECTRIC POWER

1. Above are the shapes of some arch dams. What do all of these shapes have in common? Why?

2. For what reasons were the first dams built?

3. Hydroelectric power depends on solar energy. Explain.

4. Why is hydroelectric power considered to be a renewable resource?

5. What determines the amount of power that a dam can provide?

6. In addition to supplying hydroelectric power, what other benefits do dams provide?

7. What is the estimated amount of water that evaporates yearly?

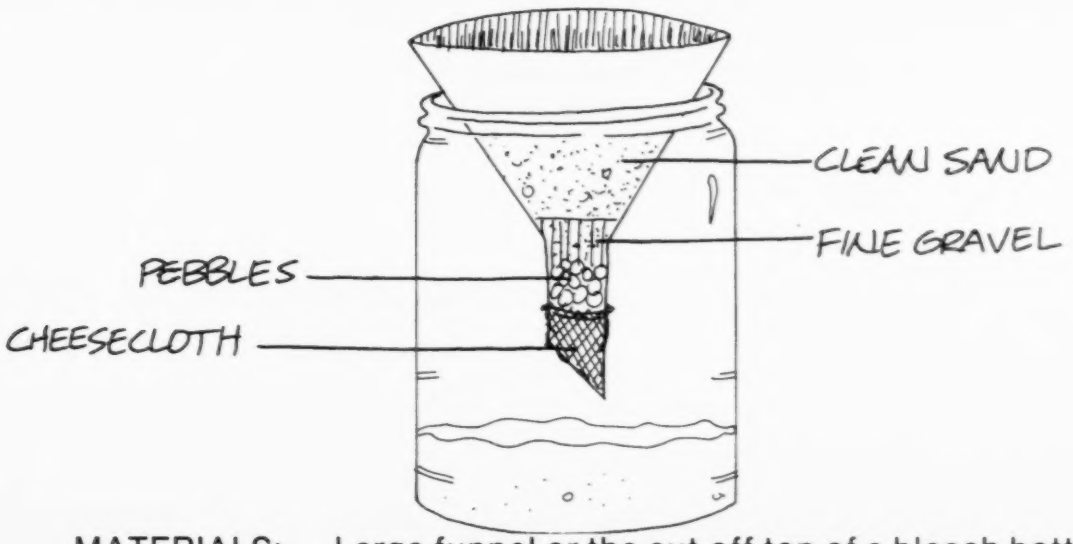
8. How does this water return to the earth?

9. Does your home receive electrical power from a hydroelectric plant?

10. Do you know where the nearest dam to your home is located?

CLEAN WATER BY FILTRATION

One of the steps in water purification is filtration. While filtering water does not remove all the microorganisms, it does remove most of the soil and dirt in water. To show how water is filtered, do the following demonstration:



MATERIALS: Large funnel or the cut-off top of a bleach bottle, jar, cheesecloth, string, small pebbles, gravel, sand, and muddy water.

PROCEDURE: Prepare the funnel as shown above. Pour the muddy water into your filtering system. Describe the color of the water before and after filtering. To investigate the presence of bacteria in the filtered water, obtain a sterilized culture (Petri dish) from a hospital or lab. With an eyedropper which has been sterilized by boiling, drop a small amount of the filtered water into the Petri dish by carefully lifting the lid on one side just wide enough to allow the eyedropper inside the Petri dish. Allow the culture to grow in a warm place out of direct sunlight for several days. Look for bacteria and mold colonies in your culture. *Destroy culture by burning in an incinerator. Do not open Petri dish once bacteria begin to grow.*

QUESTIONS:

1. What substances are removed by filtration?
2. Why is water further purified after filtration by adding chlorine?

WHICH USES LESS WATER, SHOWER OR TUB?

Most people think tub baths use less water than showers. To test this theory, do the following experiment.

MATERIALS: Tub, shower, soap, towels, washcloth, yardstick, and water.

PROCEDURE:

1. Fill your bathtub as you usually do before taking a bath, but before you step into the tub measure the water. If you add any water while bathing, remeasure when you step out.

2. The next time you take a shower put a stopper in the drain. Then take your shower as you usually do. When you finish, measure the water before removing the drain.

	Number of Inches of Water
Shower	
Bath	

WATER CYCLE

Cycle means circle. In this activity, you will put the various stages of the water cycle in their proper order.

MATERIALS: Scissors. Paper plates and glue are optional.

PROCEDURE: Cut out the pieces of the water cycle on the next page. Use the pieces to form a clockwise circle. Begin at the twelve o'clock position with the piece described in number one. Continue until the cycle is complete. The pieces may be glued onto a paper plate for a more permanent arrangement.

1. Water from the clouds falls to the earth in the form of precipitation—rain, snow, sleet, etc. Put this piece in the twelve o'clock position.

2. In the two o'clock position, place the drawing showing rainwater that has collected in streams, rivers, lakes, etc.

3. The drawing in the four o'clock position shows river water going to a water purification plant for removal of germs and impurities.

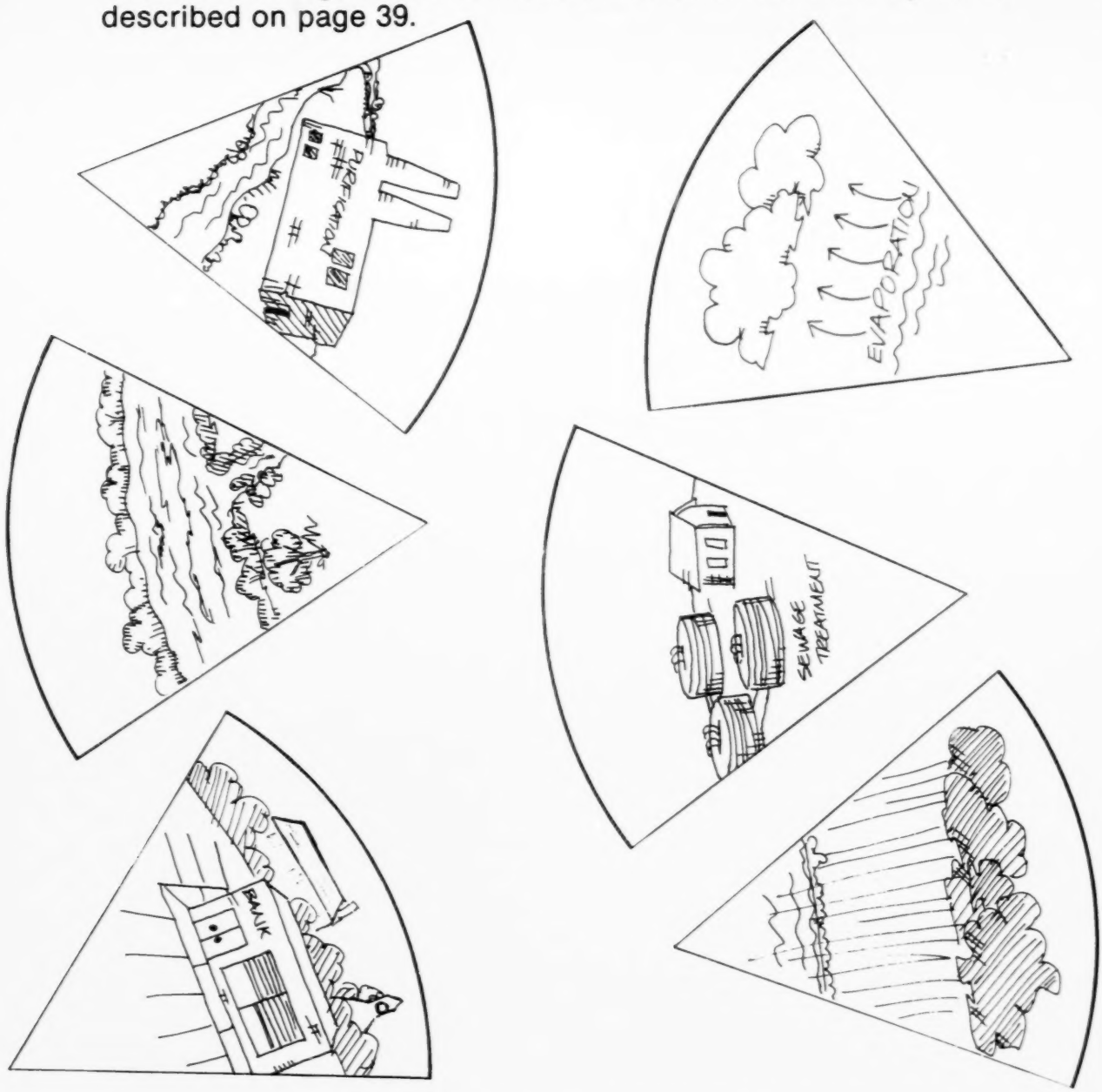
4. The six o'clock position shows water is used in homes, factories, and businesses.

5. The next piece, or the eight o'clock position, shows sewage or waste water being treated in a sewage treatment plant.

6. The last piece, or the ten o'clock position, shows the water being returned to the lakes, streams, and rivers and evaporating into the sky to form rain clouds.

WATER CYCLE

Use the drawings below to make a model of the water cycle as described on page 39.



QUESTIONS:

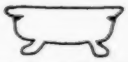
1. Do you know the source of the water you use in your home?

2. Do you know how the water you use in your home has been purified?

3. Do you know how much you pay each month for pure water?

WATER USAGE

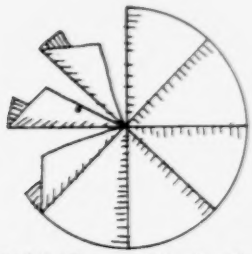
Listed below are the average amounts of water used in some everyday activities. Use the figures and symbols below to construct a pictograph on the bottom of the page. In a pictograph, a symbol is used to represent a number. Each symbol represents five gallons of water used. Use parts of symbols to represent usage of less than five gallons. To keep your pictograph neat, put symbols directly under each other.

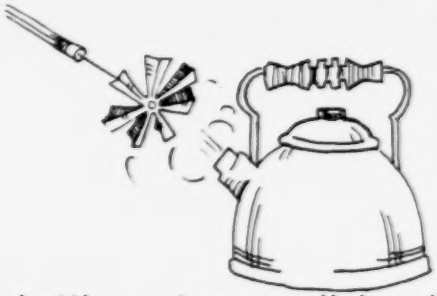
HOW WATER IS USED	SYMBOL	HOW MUCH WATER IS USED
Bath		30 gallons
Shower		20 gallons
Load of Dishes		10 gallons
Automatic Washer		32½ gallons
Washing Hands		2½ gallons

HOW WATER IS USED	WATER USAGE
Bath	
Shower	
Load of Dishes	
Automatic Washer	
Washing Hands	

STEAM POWER

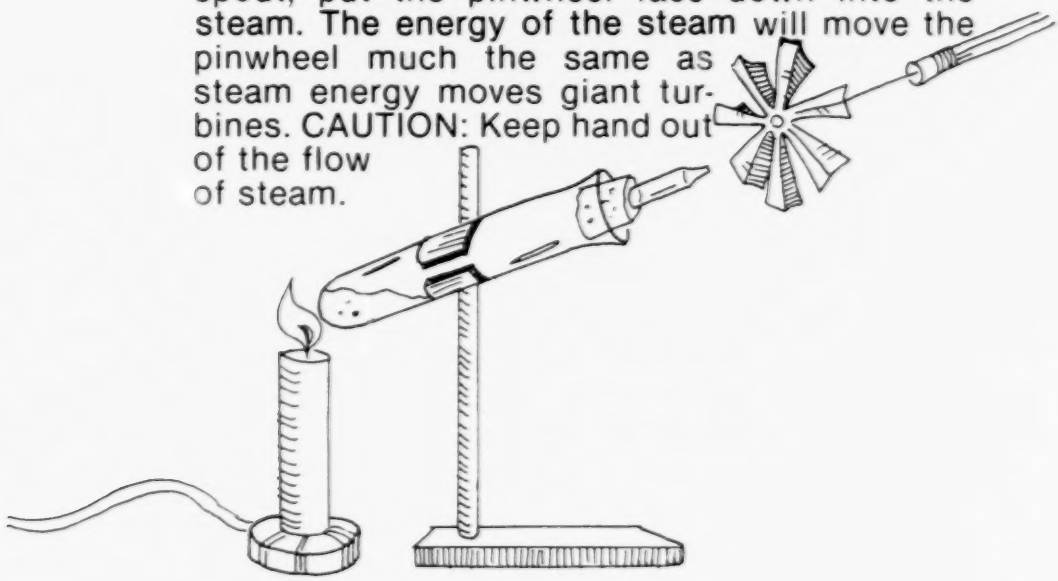
The following demonstration will show how steam can be made to do work.





MATERIALS: Hot plate, teakettle, water, pencil, bead or small button, straight pin, and an aluminum pie tin.

PROCEDURE: Cut a circle three inches in diameter from the pie tin. Cut eight slits in the circle and bend as shown above. Put the pin through the center of the foil and then through either the bead or the button. Stick the pin into the eraser of the pencil. Heat the water in the teakettle to a rapid boil. When a good flow of steam comes from the spout, put the pinwheel face down into the steam. The energy of the steam will move the pinwheel much the same as steam energy moves giant turbines. CAUTION: Keep hand out of the flow of steam.



NOTE: A large test tube with a one-hole stopper and the glass portion of a medicine dropper or a small piece of glass tubing can be used instead of the teakettle. Use a Bunsen burner to heat the test tube. CAUTION: Always point test tube away from face, and be careful when inserting tubing into stopper.

IS THE SUN THE ANSWER?

Even though the sun is 93,000,000 miles away, this ball of burning hot gases is the primary source of all energy on earth. No one can be certain for how long the sun remained early man's only energy source before he discovered and learned to use fire. Today, we still look to the sun for energy.

Without sunlight, our fossil fuels, whose power has been locked up for millions of years in the remains of ancient plants and animals, could never have existed. The sun is also the supplier of energy for evaporating water from rivers, lakes, streams, and oceans. This water, stored in clouds, eventually falls as rain and snow. Collected in dams, it turns the giant turbines in hydroelectric plants.

The unequal heating of the earth's surfaces by the sun produces wind energy which can be converted into mechanical and electrical energy by windmills.

Even the stored heat in geysers is traced to the sun. Geysers can be converted into geothermal energy. This energy source is very popular in Iceland where geysers are common.

Solar energy remains the cleanest, as well as the most inexhaustible, energy source. It is also truly renewable. One of man's greatest challenges to be met is in utilizing the power of the sun. The fossil fuels we depend on so largely today were once thought to be inexhaustible, but now we know differently. The sun, which has been supplying energy for billions of years, is the only source we have that is likely to continue for billions of years.

IS THE SUN THE ANSWER?

1. What is the distance of the earth from the sun?

2. What is the sun?

3. Why is no one certain of how long the sun was man's only source of energy?

4. The power of the sun has been locked up in fossil fuels for millions of years. What is meant by that sentence?

5. What are some ways in which the sun indirectly supplies us energy?

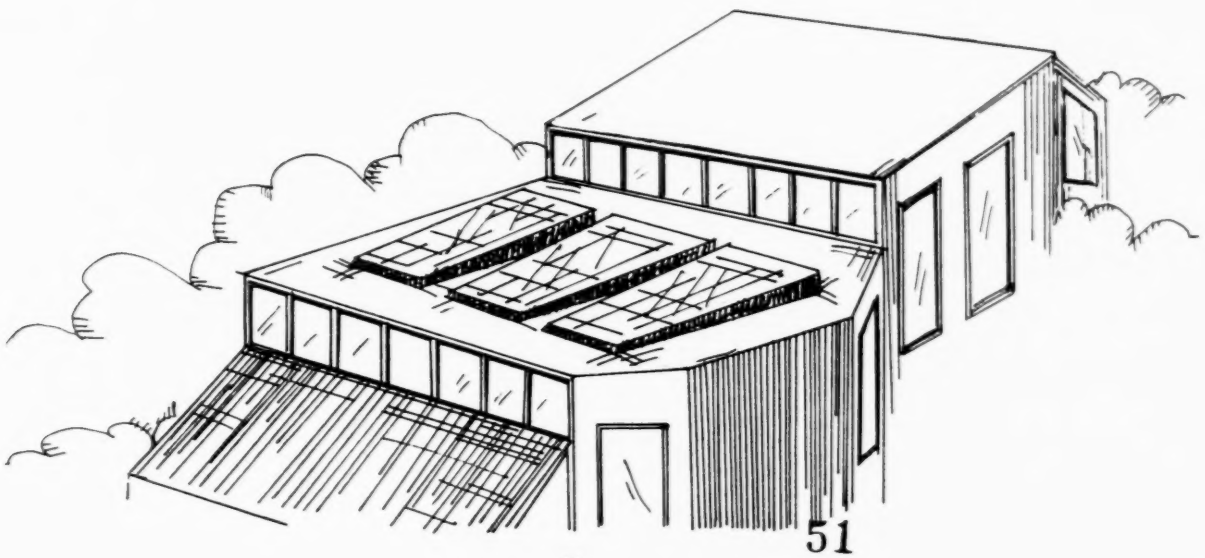
6. Why is solar energy the cleanest source of power?

7. How is the sun responsible for wind?

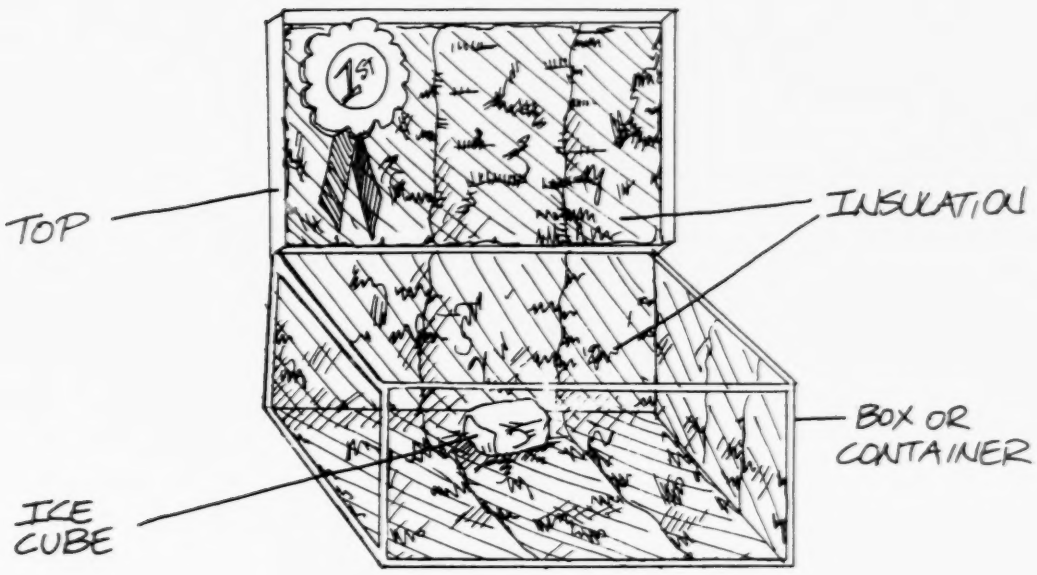
8. Why are geysers important in Iceland?

9. Do you believe new ways will be found to use solar energy? Why?

10. Why is the sun the only energy source likely to continue for billions of years?



AN ENERGY SAVER'S CONTEST



Try having an energy-saving contest. Students will compete to find out who can build the best "refrigerator." Thermos jugs and ready-made coolers cannot be used; only raw materials and containers to hold the contents are allowed.

MATERIALS: A variety of materials, such as cardboard, styrofoam, newspaper, wood, plastics, etc. Ice cubes, all the same size, one for each "refrigerator."

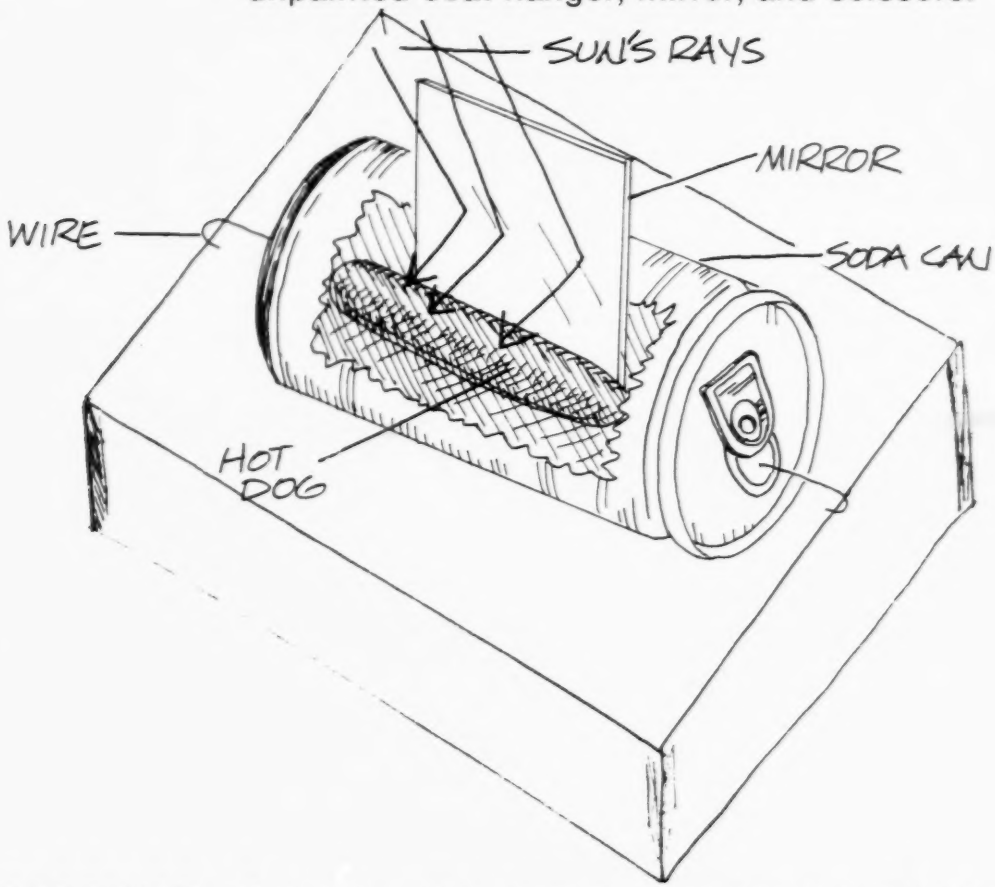
PROCEDURE: Students will make their "refrigerators" at home. They will bring them to class on the same day. One ice cube will be placed in each "refrigerator." The "refrigerators" will be checked at hourly intervals. The student whose ice cube melts last is the winner! It is a good idea to put a size limit on "refrigerators."

VARIATION: At a later time the "refrigerators" can be tested to see how well they retain heat. One thermometer and a cup of boiling water will be needed for each entry. The container which retains the heat the longest wins.

A SOLAR COOKER

A solar cooker uses the energy of the sun to cook food. It does this by reflecting the sun's rays and concentrating them on the food to be cooked. You can make a simple solar cooker by following the directions below. Remember, you must use your cooker on a sunny day, and you must give the food plenty of time to cook.

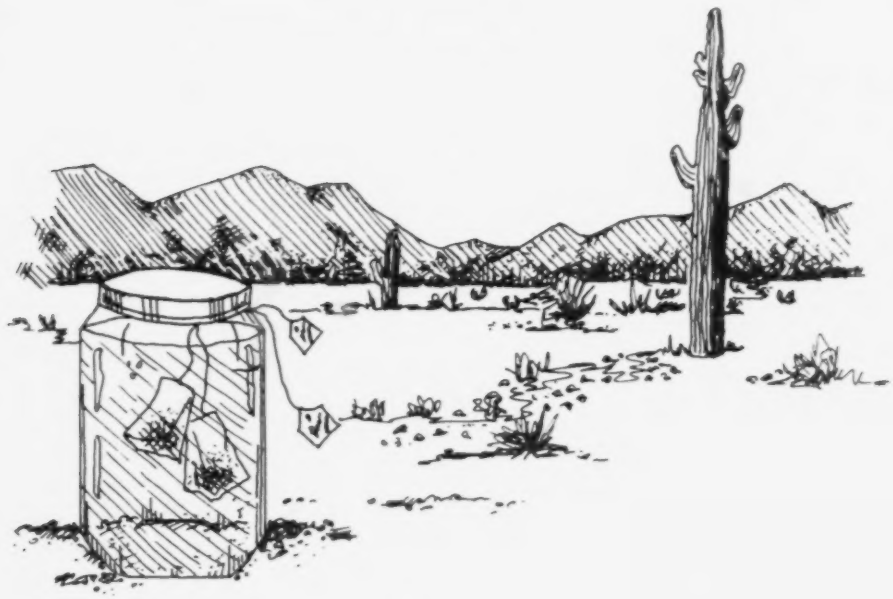
MATERIALS: Shoe box, aluminum can, aluminum foil, clean unpainted coat hanger, mirror, and scissors.



PROCEDURE: Cut out a strip from the can about two inches wide. Carefully bend back all the sharp edges, and line the inside of the can with aluminum foil. Push the wire through one end of the can, through a hot dog, and finally through the other end of the can. Hook the can in place on the shoe box by bending the ends of the coat hanger. Place a mirror inside the can where it can best reflect the sun's rays onto the hot dog. It will probably take about forty-five minutes for your hot dog to cook. CAUTION: Do not look directly at the sun or its reflection in the mirror.

MAKING SOLAR TEA

In energy poor countries of the world, more ways are being found to make the sun do work. You, too, can use the sun (solar power) to do work for you as do people in desert regions who make tea without boiling water. To make solar tea, follow the directions below.

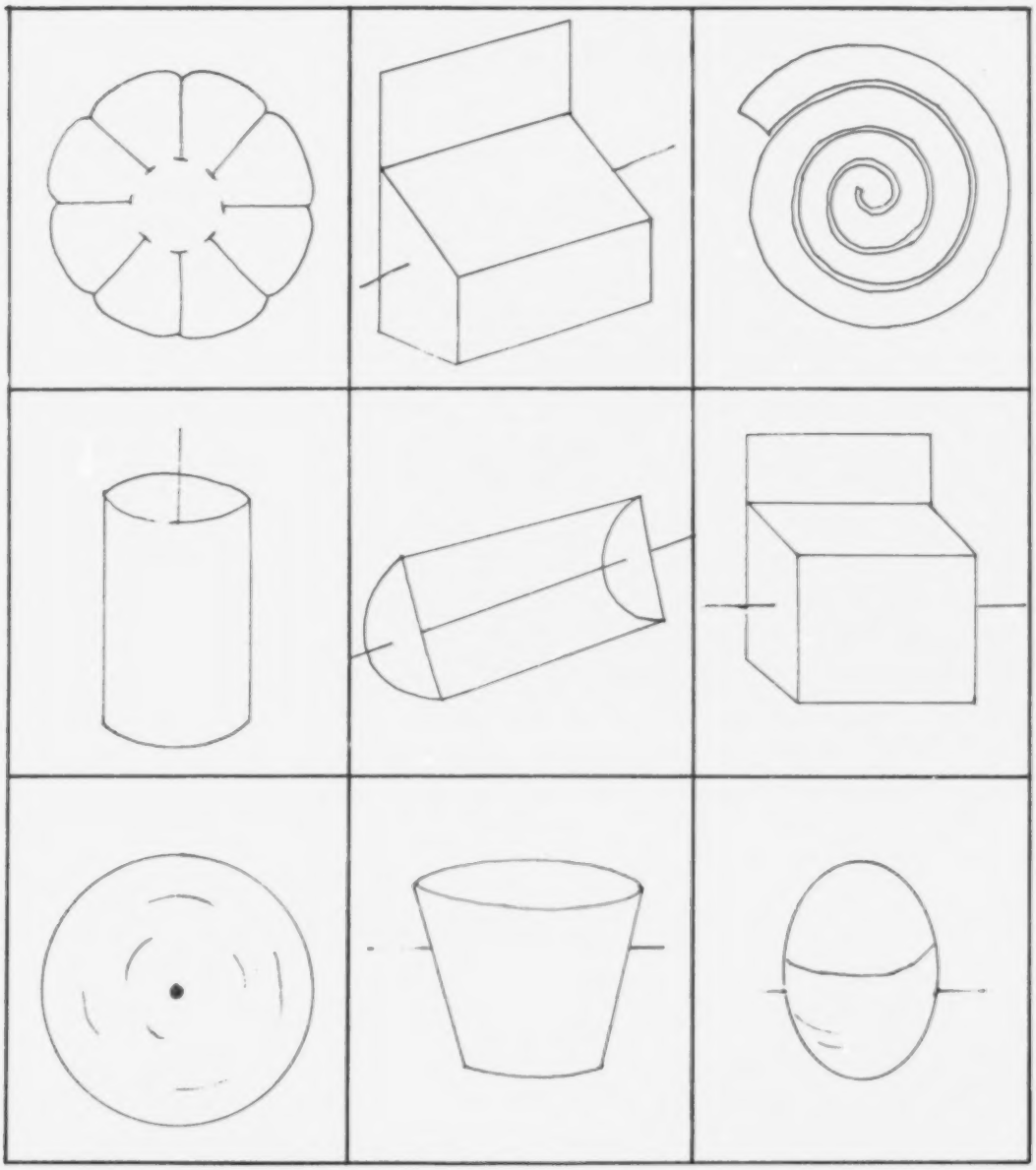


MATERIALS: Glass jar, cap, tea bags, sunlight, and sweetener, if desired.

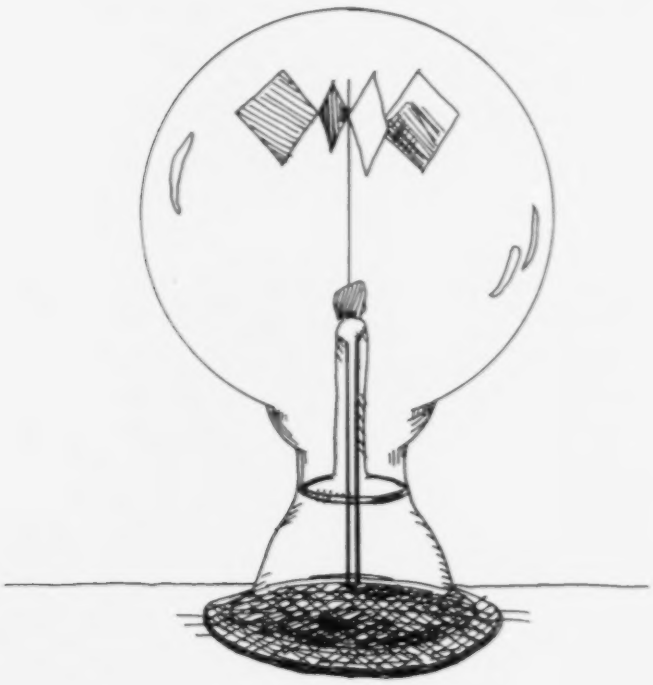
PROCEDURE: Fill the jar with water. Use two to three tea bags for each quart of water. Set in direct sunlight. Leave the jar in the sun until it is the strength (color) you like. Add sugar or sweetener to suit your taste.

MAKE A BETTER SOLAR COOKER

Have a solar cooker contest to find the best design for raising the temperature of solar energy. Below are some design suggestions, but feel free to experiment with shapes and designs of your own. The solar cooker which reaches the highest temperature after forty-five minutes in the sunlight is the winner. All you need is your homemade solar cookers and one thermometer for each cooker. WARNING: Do not look directly into the sun or its reflection.

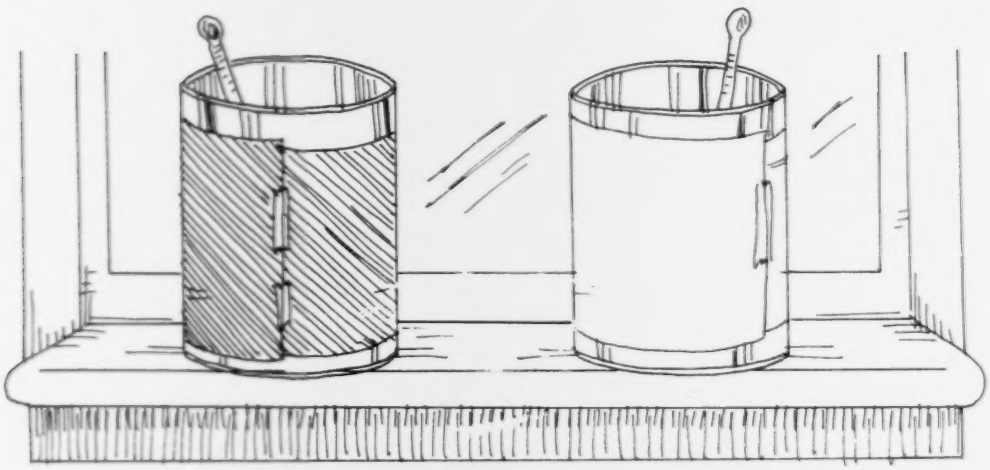


RADIOMETERS AND RADIANT HEAT



Radiometers are inexpensive instruments that demonstrate radiant heat. They are easily purchased from hobby shops or ordered from scientific supply houses. Radiometers are glass bulbs from which most of the air has been removed. Inside the bulb are four vanes mounted on a rotating shaft. One side of each vane is painted black and the other side is painted either white or silver. If you place a radiometer in the sun, the vanes will spin. The more light, the faster the vanes spin. The spinning is due to the unequal heating of the vanes. The black sides of the vanes absorb heat faster than the white sides, thereby heating the air molecules on that side and causing them to move more quickly. The movement of the air molecules against the vanes causes them to spin.

WHICH COLOR ABSORBS HEAT FASTER?



PURPOSE: To show which color, black or white, absorbs heat faster.

MATERIALS: Two thermometers, two clean tin cans of equal size, white and black construction paper, tape, sunlight or gooseneck lamp, and water. (Cans may be painted instead of using construction paper.)

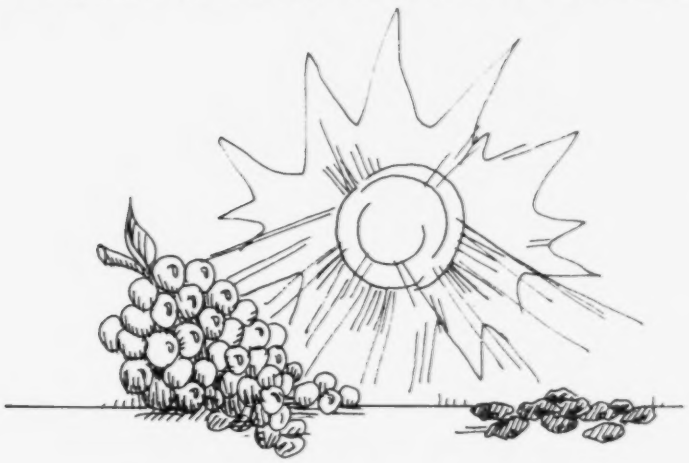
PROCEDURE: Cut the construction paper to fit around the cans. Tape the white paper around one can and the black paper around the other. Fill each can to the same level with water. Place a thermometer in each can and set the cans in bright sunlight or in front of a gooseneck lamp. (Be sure cans are the same distance from the bulb of the lamp.) Take several readings fifteen minutes apart.

TIME	TEMPERATURE IN WHITE CAN	TEMPERATURE IN BLACK CAN

VARIATION: Try using other colors. Compare results.

QUESTION: How can the results of this experiment be applied to everyday life?

TURN A GRAPE INTO A RAISIN



MATERIALS: One or two cups of grapes, plastic screen, cardboard box, cord, and tape or stapler.

PROCEDURE: Select a cardboard box that is only a few inches high. Cut the center out of the top and bottom, leaving a two-inch border around the edges. Tape or staple pieces of plastic screen to cover the holes. (Be careful not to lose any staples in the box.) Spread grapes over the plastic screen, cover with top, and hang in a sunny place outdoors until the grapes resemble raisins. Bring indoors at night or when raining.

VARIATION: Try other fruits, such as thin slices of apple. Fruit can also be dried by using very low oven temperatures and allowing the fruit to remain in the oven for long periods of time.

OLD TIMERS' SURVEY

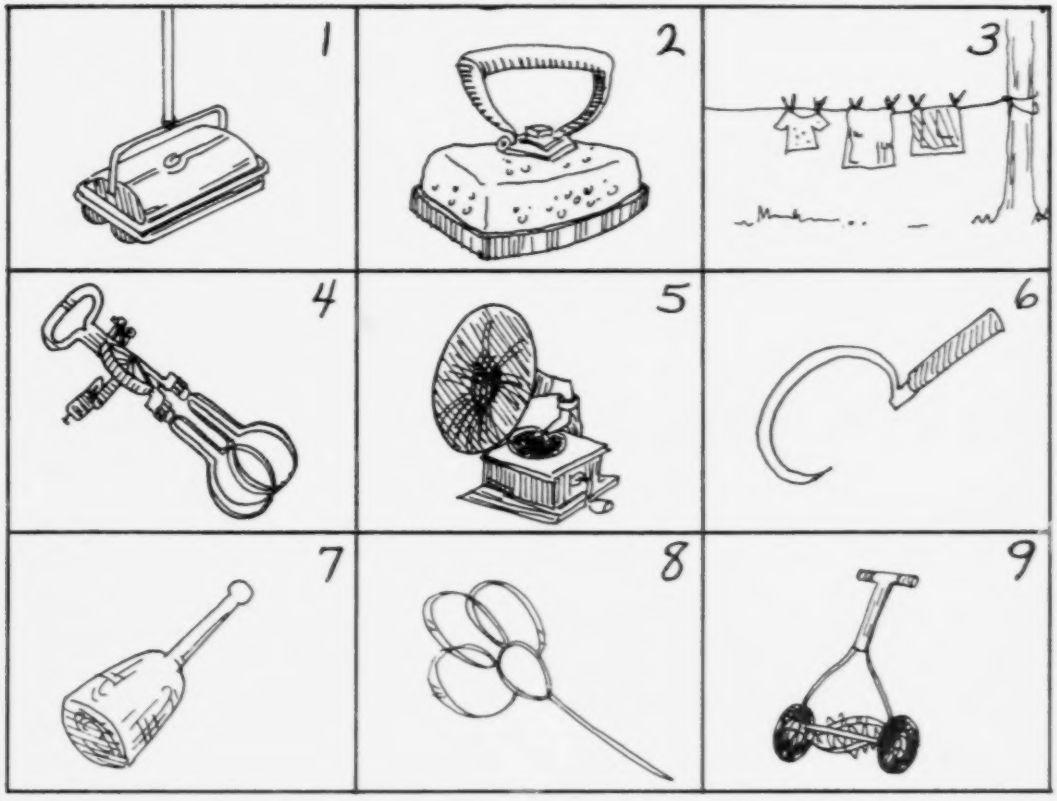
Interview one of the oldest persons you know. A grandparent or great-grandparent would be a good choice. Compare his or her life at your age to your own life at the present time. Remember to be courteous and considerate. You may want to add some questions of your own.

1. Where did you live when you were my age?
2. How did you get to school?
3. How was your home heated?
4. Did your family own a car?
5. What kind of car was it?
6. What kinds of food did your family eat—fresh, home canned, frozen?
7. What did your father do to earn a living?
8. Did your mother work outside the home?
9. Did she drive a car?
10. What was your favorite recreation at home?
11. What was your favorite recreation away from home?
12. Did your family have a telephone? If so, how many?
13. How were the clothes washed in your home?
14. How were the clothes dried?
15. How was water supplied to your home?
16. Did you listen to the radio?
17. What was your favorite program?
18. What things were better then than they are now?
19. What things are better now than they were then?
20. What do you miss most about the "good old days"?

Report to your class the results of your interview. If a tape recorder is available, you may wish to put your interview on tape.

THE GOOD OLD DAYS

Many of the following old-fashioned inventions required only the energy of the human body to make them work. They have all been replaced. Can you tell how each one was originally used?



FOLLOW UP: Students may wish to bring old objects or pictures to class for identification and display. Discuss the uses of the various objects and the reasons they are no longer in popular use.

ENERGY TIME LINE

Important Dates in the History of Electricity and Energy

1800 — Alessandro Volta made the first battery.

1825 — Georg Ohm discovered resistance in conductors.

1751 — Benjamin Franklin proved lightning is electricity.

1822 — André Ampére discovered electromagnetism.

1879 — Thomas Edison made the first light bulb.

1831 — Michael Faraday changed magnetism into electricity.

1905 — Albert Einstein said matter and energy are equal.

1954 — The United States launched the first nuclear-powered submarine, the *Nautilus.*

1898 — Marie Curie discovered radium.

1859 — Edwin Drake sank the first oil well in Titusville, Pennsylvania.

1769 — James Watt invented the modern steam engine.

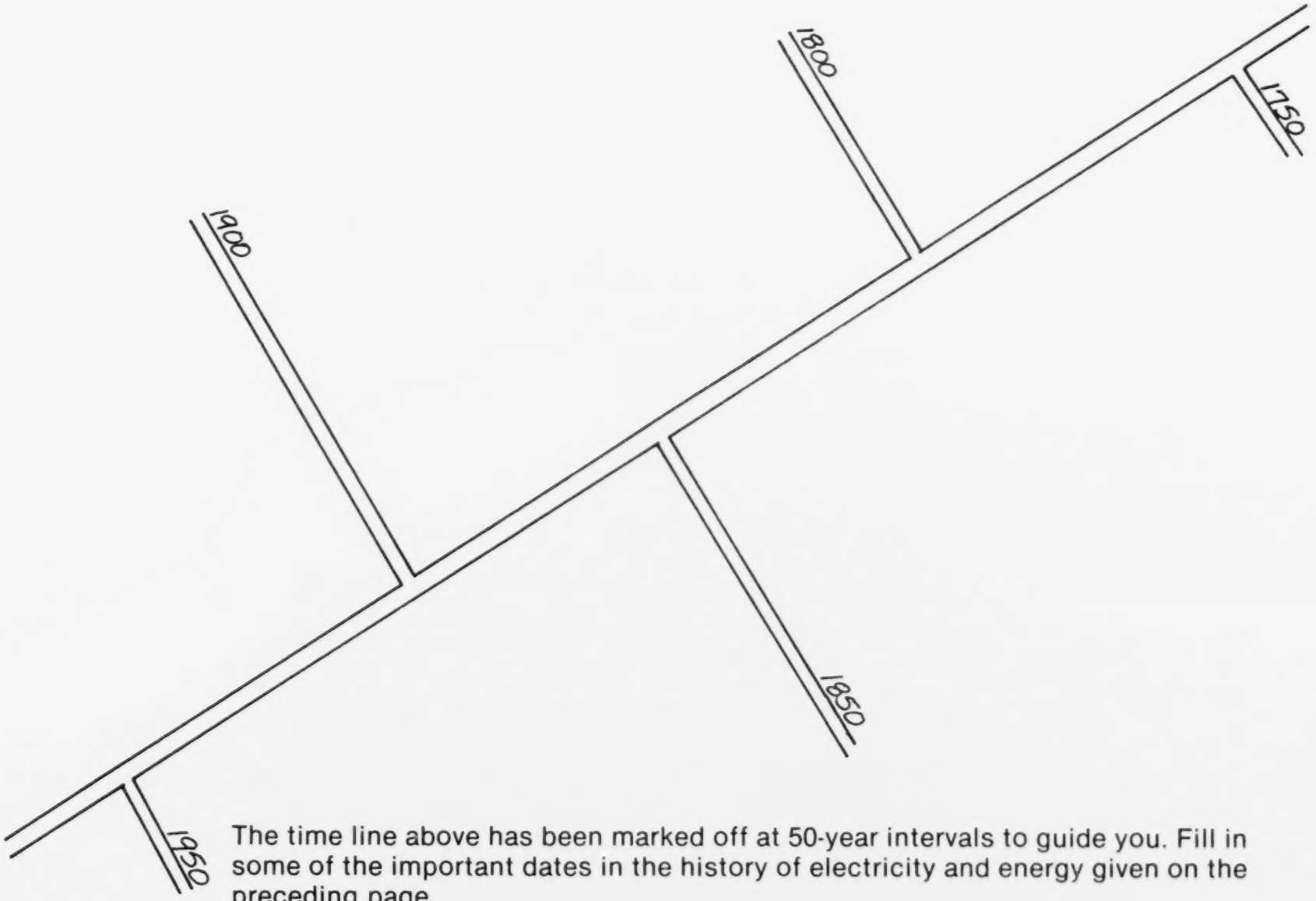
1807 — Robert Fulton built a successful steamboat.

1815 — George Stephenson built the first steam locomotive.

1910 — Henry Ford built the "Model T."

1903 — Wilbur and Orville Wright made their first successful airplane flight.

ENERGY TIME LINE



The time line above has been marked off at 50-year intervals to guide you. Fill in some of the important dates in the history of electricity and energy given on the preceding page.

A NUCLEAR POWER STATION

Nuclear power stations use uranium as fuel. Small amounts of uranium are put into tubes in the reactor's core. They are circulated in the tubes by a coolant. Neutrons moving in the core act as bullets splitting uranium atoms. The splitting, or fission as it is called, produces great amounts of heat. Control rods act as guards by absorbing excess neutrons. It is their job to keep the chain reaction caused by the splitting of atoms from getting out of hand. Extra control rods are safety rods which can shut down the reactor quickly in times of emergency.

In each circle on the following page, write the number of the statement that describes a part of a nuclear reactor.

1. The core of a nuclear reactor. It contains and splits the uranium fuel.

2. Control rods. They absorb excess neutrons; they also keep nuclear reactions from getting out of hand.

3. Water, heated by the splitting of uranium atoms, leaves the reactor.

4. The heat exchanger turns the water into steam.

5. Steam leaves the heat exchanger.

6. The giant turbine is turned by steam.

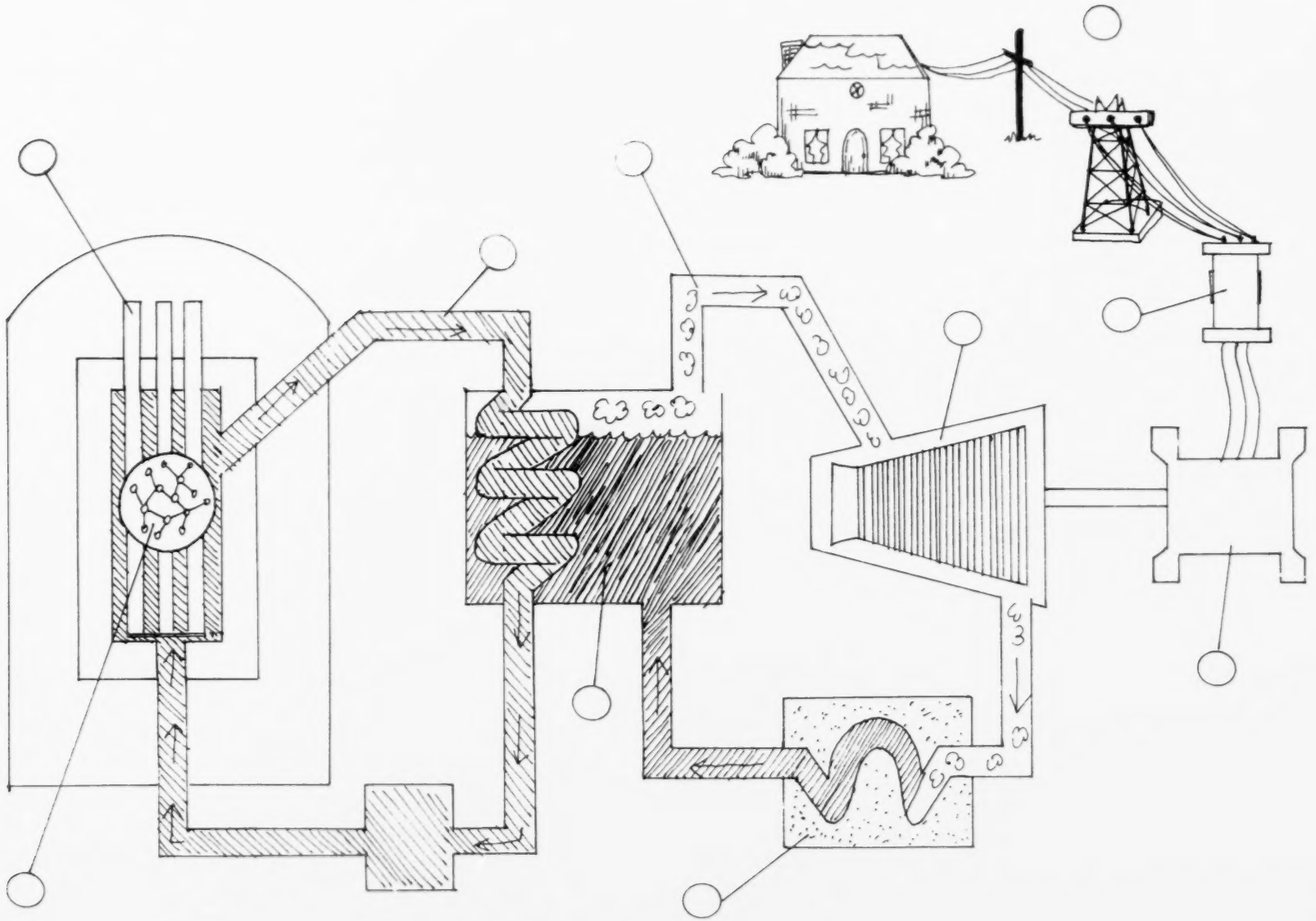
7. Steam is condensed back into liquid water and is returned to the heat exchanger.

8. The generator produces electricity.

9. Transformers change the electricity by increasing or decreasing voltage and amperage before sending it on transmission lines.

10. Power lines transmit (send) electricity to homes and businesses.

NUCLEAR POWER STATION



57

65

66

THE ENERGY GAME

When your students have finished studying about energy, you may wish to review by playing the energy game.

MATERIALS: One copy of The Energy Game on page 59 for each student.

PROCEDURE: Have the students answer as many questions as possible before checking answers. The teacher may wish to have students check their own papers or exchange them with classmates. The teacher will provide the correct answers and put the scale of correct answers on the board.

SCALE OF CORRECT ANSWERS

1-5 Dry well. You need to study.

6-10 You've made a start but need more information.

11-12 You hit shale but no oil. Sorry. Keep drilling.

13-14 You just struck oil! Congratulations!

Students will fill in their own names and scores on the center of The Energy Game sheet.

THE ENERGY GAME

1. The primary source of energy is the _____.

Your energy is solarific; go to 2.

$E = MC^2$

2. Energy that comes from splitting uranium atoms is called _____.

You are glowing. Watch out for stray neutrons!

3. Energy is the ability to do _____.

Careful, moving objects!

4. Who dug the first oil well?

_____.

Quack! Quack!

5. Heat from geysers is known as what type of energy?

_____

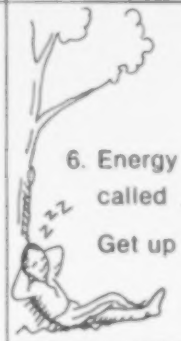
Old Faithful was never like this!

_____

Date

6. Energy at rest is called _____.

Get up and go!



14. A black rock that burns is _____.

You're hot now!

_____

has plenty of energy and will soon strike oil.

_____

score

13. True or false. Electricity always follows the path of least resistance. _____.

Don't get turned off; one more to go.

7. What is the electrical symbol for a light bulb?

_____

Glow on!

12. Which is a better conductor of heat, copper or glass? _____

Conduct yourself upward!

11. Electricity is measured in _____ hours.

Don't kill any more time! Proceed to the left.

10. Who dug the first well for natural gas?

_____.

You're "hartly" finished. Go to 11.

9. Moving energy is called _____ energy.

Move on!

8. Electricity is the flow of _____.

You are currently headed in the right direction.

ANSWER KEY

Page 1: 1. Force 2. Work 3. Work 4. Work 5. Work 6. Work

Page 2: 1. K 2. K 3. P 4. K 5. P 6. K 7. K 8. P 9. P 10. K 11. P 12. P 13. K 14. P 15. P 16. K

Page 4: 1. natural gas 2. solar 3. nuclear 4. hydroelectric 5. wind 6. coal 7. geothermal 8. wood 9. petroleum

Page 6:
1. Edwin Drake, Titusville, Pa., in 1859.
2. Yes
3. Lighting, cooking and waterproofing of ships.
4. The internal combustion engine and Henry Ford's "Model T" car.
5. Heating homes, fuel for electric power plants, industrial uses, manufacture of petrochemicals.
6. Nonfuel products made from petroleum.
7. Synthetic rubber, medicines, plastics, solvents, textiles, paints, fertilizers, and construction materials.
8. A substance whose molecules consist mainly of hydrogen and carbon atoms.
9. The hydrogen and carbon atoms can be arranged in a variety of ways. The new arrangements result in new products.
10. Petroleum has given us many modern products.
11. Answers will vary.
12. Answers will vary.
13. Plants and animals and before them the sun.
14. Oil was formed from the remains of ancient plants and animals compressed under rock and salt water. The pressure of the rock and the water changed the plant and animal remains into oil. The salt water also served to keep the plants and animals from decaying beyond the point at which oil forms.

Page 7: 1. sandstone 2. oil and water 3. shale 4. oil well

Page 10:
1. Capable of being molded or formed. It comes from the word *plastikos*, which means to mold or form.
2. Polyethylene, polystyrene, polyvinyl chloride
3.-7. Answers will vary.

Page 13: 1. F 2. A 3. C 4. B 5. D 6. E

Page 16:
1. A brownish-black or black rock that burns.
2. Fossil fuels were formed over very long periods of time from the remains of ancient plants and animals. Coal was formed largely from the remains of plants.
3. Oil and natural gas.
4. As ancient plants died, their remains fell to the bottom of large swamps. In time, the remains were covered by seas and sediments. The sediments changed into rock and exerted heat and pressure on the decayed plants below, changing them into peat and later into coal.
5. Cost and pollution.
6. It's mostly used as fuel in electric power plants.
7. Underground mining and strip/surface mining.
8. Underground mining is accomplished by digging tunnels into the earth to reach the coal. Surface mining occurs where layers of soil and rock are removed to reach coal which lies close to the surface.
9. Underground.
10. Coal molecules which are mostly carbon are changed into molecules similar to those of oil (hydrocarbons).
11. It ranks below oil and natural gas.
12. It is our most abundant fossil fuel.

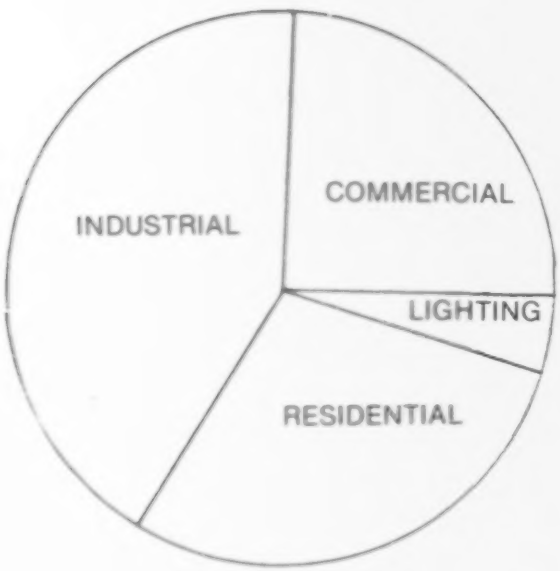
Page 20: 1.d 2.j 3.c 4.e 5.a 6.b 7.i 8.g 9.h 10.f

Page 21: Starting on the left—A: Switch, resistance, wire crossing another wire not connected, three dry cells (batteries), resistance. B: Generator, switch, resistance, resistance, resistance.

Page 23:
1. Do not pull a plug out by the wire.
2. Do not use electrical appliances while in the bathtub.
3. Do not leave electrical appliances, such as irons, unattended when they are plugged in and turned on.
4. Use the proper size burner for the pot.
5. Replace frayed cords.
6. Do not plug too many appliances into one socket.
7. Never stick a fork or any other metal object into a toaster while it is plugged in.
8. Never put your finger into a live socket.
9. Do not run wires under rugs.
10. Do not fly kites during thunderstorms.
11. Do not go near or under fallen or loose wires.
12. Do not touch electrical appliances or outlets when your hands are in water.

Page 24:
1. The electricity in diagram A went in a more or less circular path; it did not travel the complete path in B.
2. In B, the electricity took the path of least resistance and did not flow to the bell.

Page 25:



Page 28:
1. The burner is too large for the pot.
2. There is too much water in the tub.
3. There are too few clothes in the dryer.
4. The faucet is dripping.
5. The bulb is using too much wattage for ordinary use.
6. No one is watching the television.
7. There is too little food in the oven.
8. The refrigerator door is open too long.
9. There is too much heat under the pot.
10. The thermostat is set too low in the summer.
11. The thermostat is set too high in the winter.
12. The shower is left running.

Page 29: The meter reads 31570. The kilowatt usage for July is 2130 kilowatt hours.

Page 31:
1. A gas made largely of methane.
2. CH_4. In one molecule of methane there are four hydrogen atoms and one carbon atom.
3. Gas from decaying organic material that was trapped under sedimentary rock.
4. Sedimentary.
5. William A. Hart became fascinated by a burning creek. He dug the first oil well there using a hollow log as a pipe.
6. 1821 in Fredonia, N.Y.
7. Gas lamps, lighthouse.
8. Heating, cooling, cooking, washing and drying clothes.
9. Energy for industries and factories.
10. Answers will vary.

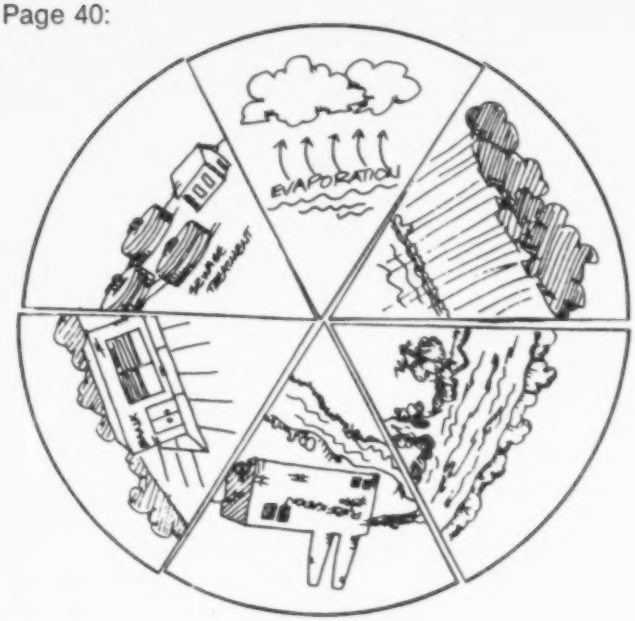
Page 34: The reading on the dials is 604100 cubic feet. July's usage is 4200 cubic feet.

Page 36:
1. They are all thicker on the bottom because the water pressure is so much greater at the bottom of the dams.
2. Storage for drinking and irrigation.
3. Water comes to the earth as precipitation; it is stored in dams then used. It is treated and returned to lakes, streams and rivers where it evaporates into the atmosphere before returning to the earth again as rain or another form of precipitation. The sun supplies the energy for the evaporation.
4. It can be used over and over again.

5. The amount of water and the distance it falls.
6. Recreation, flood control, storage for irrigation.
7. 100,000 cubic miles of water.
8. In forms of precipitation, such as rain, sleet, snow, etc.
9. Answers will vary.
10. Answers will vary.

Page 37:
1. Filtration removes most of the soil, dirt and larger pieces of matter.
2. Chlorine removes microorganisms, such as bacteria.

Page 40:



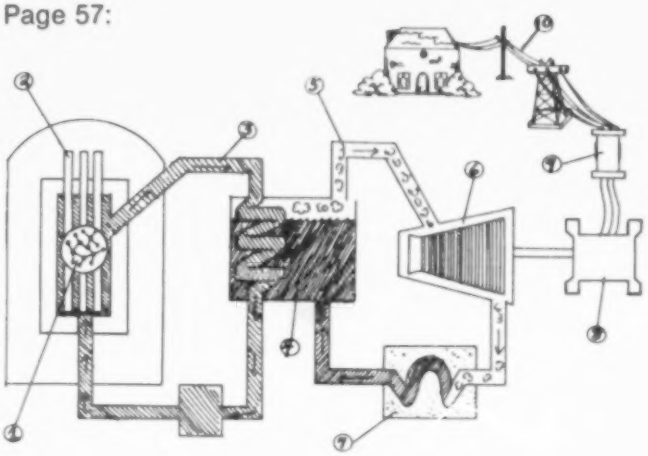
Page 41: Students should have drawn in 6 bathtubs, 4 showers, 2 cups, 6½ washers and ½ bar of soap.

Page 44:
1. 93,000,000 miles away.
2. A ball of hot burning gases.
3. The first uses of other forms of energy were not recorded.
4. Coal, oil and natural gas received most of their energy from plants, which in turn received their energy from the sun millions of years ago.
5. Wind, water and geysers.
6. There is no burning, no fumes, no impurities.
7. The sun heats the various surfaces of the earth unequally. The unequal heating causes the molecules of air to move, thereby creating wind.
8. There are great numbers of geysers in Iceland, and they have been put to use supplying energy.
9. Answers will vary.
10. The sun is so large that it is expected to take billions of years before it will burn out.

Page 50: The color of the roofs on houses, the color of clothes, paints, etc. Houses in cold climates can absorb more heat if their roofs are dark. Houses in warm climates will reflect more heat if their roofs are white or light in color.

Page 53: 1. carpet sweeper 2. iron 3. clothesline 4. eggbeater 5. phonograph 6. scythe 7. potato masher 8. carpet beater 9. lawn mower

Page 57:



Page 59: 1. sun 2. nuclear 3. work 4. Edwin Drake 5. geothermal 6. potential 7. (e) 8. electrons 9. kinetic 10. William Hart 11. kilowatt hours 12. copper 13. true 14. coal

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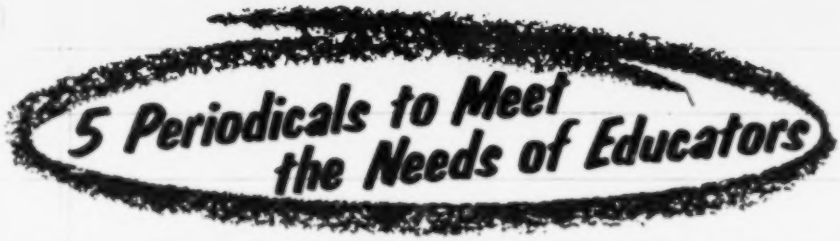

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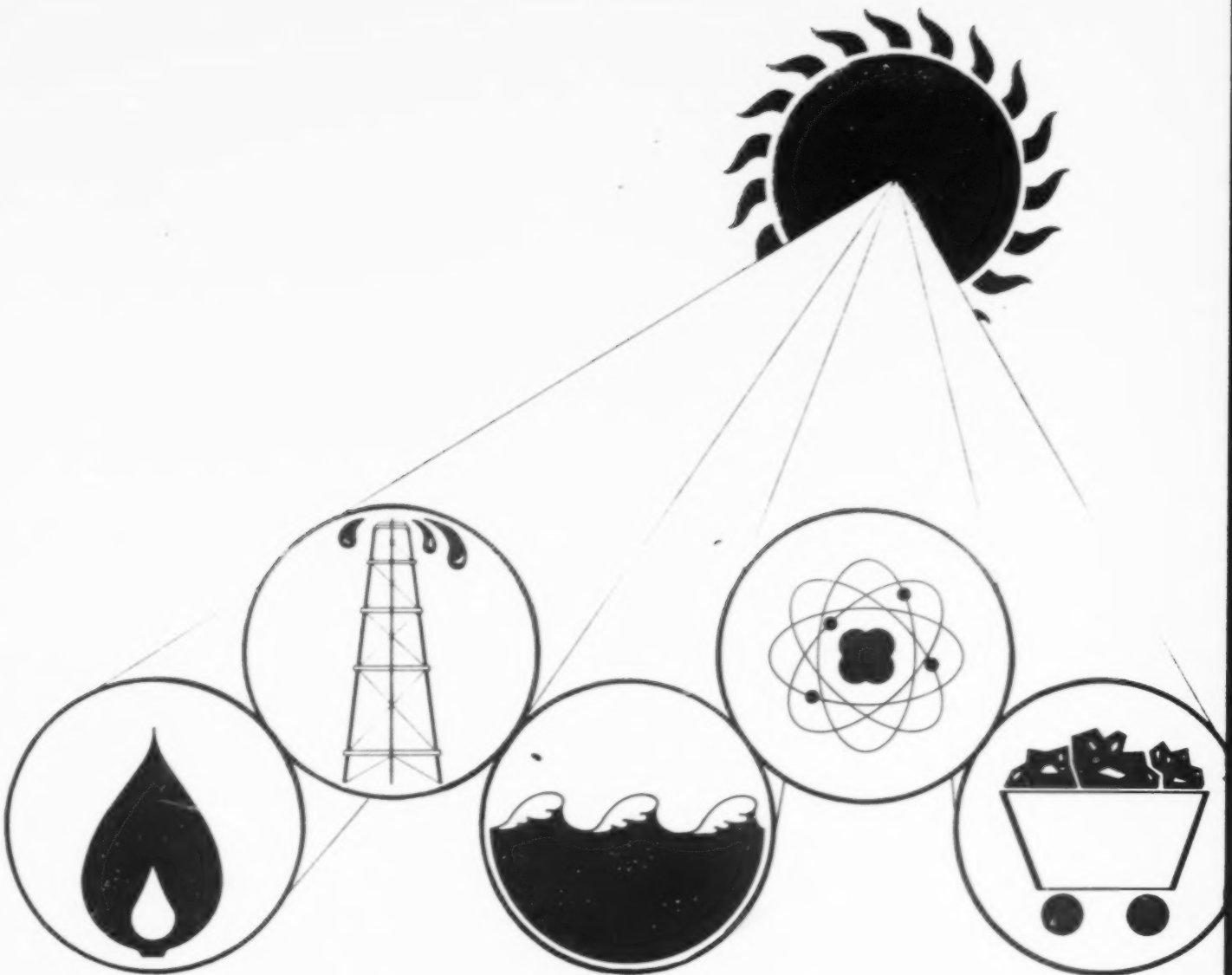

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